IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re patent application of

Andreas Schrader and Darren Carlson

Serial No. 10/603,749

Filed June 26, 2003

For MECHANISM FOR TRANSMISSION OF TIME-SYNCHRONOUS DATA

Confirmation No. 3819

Group Art Unit 2616

Examiner Ian N. Moore

DECLARATION OF KOICHI FUNAYA
UNDER 37 C.F.R. 1.132

Koichi Funaya declares as follows:

1. During the period from April 1989 to April 2001, I was employed by NEC Central Research and NEC Home Electronics in the technical fields of robotics and mechanics, DSP (digital signal processing) for mechanical control applications, high-speed channels for storage systems, MPEG transcoding, and digital rights management. During the period from April 2001 to December 2004, I was employed by Network Development Labs, NEC Networks, Enterprise Solutions BU, Solutions Development Labs in the technical fields of multimedia contents design for Digital Terrestrial Broadcasting (ISDB-T), wireless access (WLAN) solutions for carriers and enterprise, and IMS based personal communication application "Push-to-X". During the period from January 2005 to June 2006, I was employed by Infineon Technologies in the fields of technical marketing and business development on wireless semiconductor products. Since June 2006, I have been employed by Network Research Division, NEC Laboratories Europe as CPO, Research Planning and Business Development.

I graduated from University of Tokyo with Bachelor of Science degree in Aerospace Engineering in 1987, from Massachusettes Institue of Technology with Master of Science degree in Aeronautics and Astronautics in 1988, and from University of Tokyo with Master of Science degree at the School of Engineering in 1989.

2. I have read and understood the subject patent application. Briefly described, the invention disclosed therein relates to a specification of a method which allows for changing components of a (real-time) media processing and/or transmitting chain in a seamless manner. This means, core elements of the processing system (e.g. a compressor) can be exchanged by an alternative component, without the need to interrupt the data flow as is common in current implementations of media adaptation. The main mechanism used is to provide the new system elements, before the old are removed and deleted. With this technique, the flow will not be interrupted at all and any loss can be avoided during this modification process. The positive aspect of this invention is that it can be realized in software and hardware. Based on the specific requirements of the application (e.g. video conference) or device (e.g. mobile phone), different realizations can be found. From my knowledge, the inventors used JMF for the prototype. But JMF has intrinsic timing problems. That might be the reason for the remaining time synchronization problems in video transmission. This could be easily avoided, if better suited programming languages, like C, will be used. For a mobile device, the implementation would of course be realized using electronic circuitry. As far as I can observe, existing chipsets could easily support the proposed method.

3. I have read and understood the Office Action mailed September 25, 2007, in the above-identified patent application. In my opinion, the Examiner is in error when he contends that claims 13 and 14 fail to comply with the enabling requirement of the U.S. Patent Statute. One of ordinary skill in the art to which the invention disclosed in the above-identified patent application is related would have a Bachelor or Master degree in electronic engineering, computer science, or a related field. Some experiments with programming media processing software would be helpful. But ordinary programming skills would be sufficient. For hardware implementations, knowledge in low-level hardware control software programming would be helpful.

4. In the above-identified patent application, the inventors specify in claim 13 as follows: "Mechanism according to claim 6, wherein after the switching process, the subcomponents of the first processing unit are de-attached from each other". The switching process is quite straight-forward. The switch (8) in Fig. 3 is used to decide, which processing chain will receive data generated by one of the exemplified input generators (1). This can be realized in many ways. In JMF, it would mean to specify disconnecting the subcomponents are to be done automatically by JMF if a new connector (data sink) is decided for the original data source. In claim 13 nevertheless, the inventors definitely refer to the remaining subcomponents within the (disconnected) chain. Especially, if some subcomponents should be re-used for other purposes and in order to free resources, a dedicated disconnection will be helpful (e.g. JMF method "deallocate"). This would also release the implementation from additional performance requirements for synchronization and event-handling in all involved subcomponents. If other environments than JMF will be used, or if the process is realized in hardware, physical disconnection of subcomponents can be useful to avoid circuit feedback problems or to reduce energy consumption and heat problems. As to claim 14, the Examiner ignores the clear recitation and meaning of the claim. The claim refers to the variant, where some of the original subcomponents of the first processing unit will be used again as subcomponents in one of the chains in the "plurality of the second processing units". This would allow for resource-efficient implementation (in case of hardware) and speed-efficient implementation (in case of software). Especially, if the setup of a component would need some time to prepare operation, the re-use in the new processing chain ("... are included in one of the second ...") would avoid the waiting time for setting up an identical new subcomponent in the new chain. The inclusion would be realized by appropriate connectors (e.g. from switch 8 in fig. 3 to 7a of the new chain, 6b of the old chain and 7c of the new chain in order to re-use 6b).

5. I have read and understood International Patent Publication WO 00/62254 of Zahn relied on by the patent examiner. Briefly described, the Zahn reference relates to a method to organize video encoding using several processors AT THE SAME TIME. Zahn is

directed to non-linear video editing which, by definition, is not time-synchronous transmission over a network. Zahn proposes a system "in order to enable image processing at increased processing speed". The standard method would be to use several processors for calculation. Zahn mentions several drawbacks of this approach, which are mainly resulting from PCI bus overloading, since video frames or parts of video frames must be transported into main memory before processing. Other drawbacks are the additional overhead for the management, the limited scalability, and limitations of special rendering accelerators for uncompressed data transport speedup. The proposed mechanism is distributing data load in a smart way to several processing units, which operate independently on parts of the video signal.

6. I have read and understand U.S. Patent No. 6,694,373 to Sastry et al. The Sastry et al. reference relates to a mechanism to distribute processor load in a system of several DSPs or general processing chains which are able to handle several processes (streams) at the same time. Load balance is necessary to optimize the overall performance of the processor matrix within such a system.

7. In my opinion, the Examiner is in error in his rejection of the claims 1 to 4 and 6 to 18 as obvious in view of the Zahn and Sastry et al. references. Specifically, claim 1 refers to a mechanism for the transmission of time-synchronous data. Zahn does not transmit any data but operates on a single machine. Claim 2 refers to the special case of necessity to change the parameters of the system during the transmission. Zahn does not change the parameters of a video editing unit after setup. Claim 3 refers to the idea of creating a connection (switching) to the second processing unit is only done, when the setup and/or adaptation is already realized. Zahn switches before the setup, since the timing problems of component setup time do not matter for quasi-real time video editing. Claims 6 to 18 refer to different variants of the core concept. Multiple processing units could be setup in advance, if memory allows. This would reduce the switching time in case of adaptation. Zahn never switches any running processing chain, since he does not

consider any adaptation in a running chain or even complete process as soon as it is setup. Indeed, the processing chains in Zahn are also switched by a central unit in order to optimize the overall load, but no specific consideration is given to the problem of setup time of a component. The the contrary, Zahn does specifically accept a delay in setup. In page 12 Zahn states "... so that after a certain start up phase, a quasi-real time processing is achieved ... will there be a certain start up hesitation due to the calculation of the first data packets, which can be accepted."

In the subject invention of above-identified patent application, this setup time is not acceptable, since the invention deals with definitely real time processing and transmission, where no delay is acceptable. In Zhan, video editing on a single machine is optimized for load balancing between numerous processors. The claimed invention eliminates loss due to delays in setup of new processing chains (e.g. after codec) change in a running real time transmission session. Therefore, a similarity between the Zahn and the claimed invention can't be identified

Sastry et al. indeed use also different processing chains and a switch to decide which processor will handle the data processing within the stream (e.g. codec). The difference to the claimed invention of the above-identified patent application is the focus and detail of the switching method. Sastry et al. state themselves several times that the switching of active data from the first to the second processor is performed "... without significantly interfering ..." The main difference is, that in Sastry et al. all the processors are always active and perform processing operations in parallel. They are always ready to receive data for processing. The switch only decides which processor should get the data. The processor fetches the data of the respective stream out of a buffer which is fed by all streams served by this entity. Applicants, on the other hand, disclose and claim a method whereby the second processing unit (or several units) is setup AFTER the switch command (which can't be known in advance in real time traffic and will be based on varying load conditions in the network or the clients). Here the problem is that the new processing unit is not yet ready to perform during the setup phase. The claimed

invention method ensures that for DYNAMIC creation and deletion of processing chains, still no loss or interruption in the transmission will appear. Sastry et al. do not cover the problem of setup time at all.

8. I have read and understand U.S. Patent No. 7,095,717 to Muniere. Briefly described, the Muniere patent relates to a method for multiplexing two data flows in one communication channel. Specifically, Muniere deals with the problem of incoming data flows of different priorities. Muniere proposes a multiplexing method to ensure prioritized transmission of high priority data with enough remaining bandwidth for the low priority data flow.

9. In my opinion, the Examiner is in error in his rejection of claim 5 as being obvious over the combination of the Zahn, Sastry et al. and Muniere references. Claim 5 specifies the exact requirement for the switching condition in the described mechanism. "... whether at least one given parameter reaches at a predetermined value." In real time transmission of multimedia data of packet networks, the transmission quality of the channel can vary quickly and significantly over time. In order to adapt the processing parameters (e.g. of the codec, the packetizer, etc.) a complicated algorithm has to be defined in order to decide the optimum parameters based on measurement results or network feedback information. This algorithm, which is part of the proposed mechanism, will have to detect any change in any given parameter in order to decide the new parameter set. Therefore, claim 5 specifies a solid method for the identification of an appropriate switching condition.

None of the cited references specify this type of switch sensitivity to parameters. Muniere does not specify any conditions, since there is no switch involved. In Sastry et al. and Zahn, switching conditions might be defined, but they do not refer to the same decision as given in the above-identified patent application as stated above."

10. I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under 18 U.S.C. 1001 and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

28.01.2008

Date

Kouichi Funaya

NEWTON'S TELECOM DICTIONARY

The Official Dictionary of Telecommunications

- Computer Telephony
- The Internet
- IP Telephony
- Intranets, LANs & WANs
- Windows 95, NT, NetWare & Unix Networking
- Wired & Wireless Telecommunications
- Voice Processing
- Carrier Telephony
- The Intelligent Network
- ISDN & T-1
- Voice on The Internet & Intranets

14TH Updated & Expanded Edition

by Harry Newton

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plex circuit.
h Density Bipolar 3. A bipolar coding method that ow more than 3 consecutive zeros.
Disk Drive.
h level Data Link Control. An ITU-TSS link layer ndard for point-to-point and multi-point commu- In HDLC, control information is always placed in position. And specific bit patterns used for control tically from those used in representing data, so are less likely to occur. SDLC and ADCCP are sim- ols. See also HIGH LEVEL DATA LINK CONTROL.
C Another potential high definition TV standard was spawned by Britain's Independent Broadcasting Unlike Japan's Hi-Vision, HDMAC has the attraction compatible with existing TV sets, i.e. those in Europe.
Handheld Device Markup Language, which is Planet of Redwood Shores, CA's modification of HTML for use on mobile phones. HDML is a text- markup language which uses HyperText Transfer (HTTP) and is compatible with all Web servers. is designed to display on a smaller screen such as one and on a cellular phone, PDA, pager, or PCS device. c structural unit for HDML is a "card," while that of is a "page." HDML allows the mobile user to access nel, and send, receive and redirect e-mail. As PCS are graphics-challenged, a Web site must be HDML- in order to allow access by such devices.
High-bit-rate Digital Subscriber Line. The most mature SL technologies, HDSL allows the provisioning of T- local loop circuits much more quickly and at much cost than through conventional means. In the U.S., delivers T-1 (1.536 Mbps usable bandwidth) over a loop of two pairs. E-1 capacity of 2.048 Mbps three pairs. Unlike ADSL, HDSL bandwidth is sym- as equal bandwidth is provided in each direction. itional approach of provisioning T-1/E-1 access on copper wires requires specially-conditioned UTP ded Twisted Pair), with repeaters spaced every 6,000 order to compensate for signal attenuation at the high frequencies required. Each pair supports simplex ay) transmission at 1.544 Mbps, of which 1.536 Mbps for data transmission; in combination, the two sim- circuits yield a full-duplex circuit. which involves special electronics at both the CO and tomer premise, delivers the same transmission capac- standard UTP at distances up to 12,000 feet without uirement for repeaters. UTP loop may be bridged, although loading coils are not d. This is accomplished through full-duplex transmis- at 784 Kbps over each pair of the four-wire circuit; 768 is usable for data transmission, with the remaining 16 being required for signaling and control. In the aggre- the yield is 1.536 Mbps (T1). The lower transmission on each pair implies a much lower carrier frequency. As frequency signals can travel much longer distances experiencing unacceptable levels of attenuation (loss nal strength), the requirement for repeaters is obviated stances up to 12,000 feet. Note: T-1 requires 1.5 MHz each pair, while HDSL operates at frequencies ranging 80 KHz to 240 KHz, depending on the specific tech- employed. has been deployed aggressively by LECs for some years. Well over 300,000 systems reportedly are in service (as of summer, 1997). Although both the COT (Central Office Termination) and the RT (Remote Termination) require the placement of HDSL electronics, the overall carrier costs of provisioning are much reduced. No special circuit engineering, no physical inspection of cable plant, and no repeater acquisition and placement is required. Additionally, the circuit can be provisioned much more quickly, which fact results in much happier customers and much faster revenue generation. In fact, several LECs have lowered their T-1 rates in consideration of the lower costs.

At the time of this writing, a proposal for a new variation on the HDSL theme recently was proposed as a standard HDSL2, based on technology from Adtran Inc., provides the same capability over a single pair, although the local loop length is limited to about 10,000 feet. This technology also is known as SDSL (Single line DSL). S-HDSL (Single-line HDSL) is a variation on this non-standard variation (It gets confusing, doesn't it? Remember that this is an emerging technology.) run at speeds of 768 and 384 Kbps for loop lengths of 12,000 feet and 18,000 feet, respectively. See also DSL, ADSL, HDSL2, IDSL, RADSL, SDSL, T1 and VDSL. www.adtran.com and www.adsl.com

HDSL2 January 6, 1998, Level One Communications, ADC Telecommunications, ADTRAn, PairGain Technologies and the Siemens Semiconductor Group today announced agreement within the American National Standards Institute (ANSI) TIE1.4 committee on the basis on an HDSL2 standard. A provisional agreement, T1/E1 contribution number 41/97-471, has been approved marking a milestone within the ANSI HDSL2 standards effort. The elements agreed upon were line code, spectral shaping, system performance and forward error correction. These elements make up the core of the HDSL2 standard. The agreement reached is expected to accelerate the development HDSL2 technology and promote industry interoperability. The HDSL2 standard proposal will enable service providers to deliver full T-1, and potentially E-1, performance over a single twisted pair cable, with the same reach, robustness and spectral compatibility of today's two pair HDSL. This will permit local exchange carriers and telecom service providers to meet rapidly increasing demands for business and Internet access services, according to the press release I received on January 6.

HDT Host Digital Terminal.

HDTP Hoofddirectie Telecommunicatie en Post (Directorate for Telecommunications and Posts, The Netherlands).

HDTV High Definition TeleVision. Today's typical TV set in North America contains 336,000 pixels. HDTV will offer approximately twice the vertical and horizontal resolution of current NTSC analog television broadcasting, which is a picture quality approaching 35mm film. Further, it will support sound quality approaching that of a CD (Compact Disc). The ideal HDTV set would be flat screen, cheap, reliable and require very little electrical power. In December 1996, the FCC established standards for ATV (Advanced TV), the successor to HDTV, based on the recommendation of the ATSC (Advanced Television Systems Committee). See ATV, HIGH DEFINITION TELEVISION and NTSC.

HDX Half DupleX.

HE See HEAD END.

Head A device that reads, writes, or erases data on a storage medium. The device which comes in contact with or comes very close to the magnetic storage device (disk, diskette, drum, tape) and reads and/or writes to the medium. In com-

...fast as you can move the mouse. Another term for ... Cursor Submarining.

...Potato A person who uses his mouse to view edu... entertainment on his computer. Museums are ...example, that if they sell the electronic rights of the ... on their walls, every one will stay at home, ...use potatoes and never visit the museums. The ...a mouse potato derives from a couch potato — ...one who sits on his couch and changes chan... TV set using a remote device.

... ...Oxide Varistor. A voltage dependent resistor ...bs voltage and current surges and spikes. This ...effective device can sustain large surges and switch ...nanoseconds. It is used as a surge protector and ... It often the first electronic component that elec...ing in on an incoming phone line hit. Many trunk ...side PBX are protected by MOVs. If the voltage or ... high, it will blow the MOV, thus protecting the ...the far more valuable devices on the board.

..., Adds and Changes MACs. Any of the above ...work performed on a PBX switch, cabinet, or periph... after installation. See MAC for a fuller explanation.

... What the guys at Netscape called their Mosaic ...new Web browser software (later to be known as ...Navigator).

... ...OA Client. An ATM term. A protocol entity that ...s the client side of the MPOA architecture. An ...client implements the Next Hop Client (NHC) func... of the Next Hop Resolution Protocol (NHRP). See ...

... ...blished in 1991, the original Multimedia PC (MPC) ...n was adopted worldwide as the basic multimedia ...of the PC standard. IN 1993 it was followed by ...C3, the latest, does not replace MPC2, but takes it further. See MPC3.

... See MPC3.

... ...C3 is the latest specification for multimedia PCs ...by the Multimedia PC Working Group, an indepen...ial interest group of the Software Publishers ...ion (SPA). Minimum requirements for MPC3 ...include: 1. Support for MPEG-1 and other soft...mented video codecs; 2. 75 MHz Pentium or sim...essor; 3. Quadruple speed CD-ROM drive; 4. ...sound card.

... MPEG is commonly known as a series of hardware ...ware standards designed to reduce the storage ...nts of digital video, i.e. video recorded digitally or ...d into digital bits. MPEG is most commonly known ...compression scheme for full motion video. The word ...is actually the acronym for the Moving Pictures ...Group, a joint committee of the International ...ds Organization (ISO) and the International ...hnical Commission (EG). The first MPEG specifica...n as MPEG-1, was introduced by this committee in ...The common goal of all MPEG compression is to con...equivalent of about 7.7 meg down to under 150 Kb, ...represents a compression ratio of about 52 to one. The ...ements of MPEG-1 are 30 frames per second of ...Image Format (SIG) of 352 pixels x 240 pixels and ...y sound at 44.1 Khz, 16 bit stereo. MPEG image ...offers more compression than the other poplar JPEG ...compression scheme, which is largely for still images. ...takes advantage of the fact that full motion video is ...of many successive frames consisting of large areas that are not changed — like blue sky background. While JPEG compresses each still frame in a video sequence as much as possible, MPEG performs "differencing," noting differences between consecutive frames. If two consecutive frames are identical, the second can be stored in remarkably few bits. MPEG condenses moving images about three times more tightly than JPEG. See also JPEG.

There are two types of MPEG Playback: Software and Hardware. Software MPEG playback is the decompression of MPEG video and audio files using the processing power of the CPU. Hardware MPEG Playback uses an add-in card to deliver full-screen, full-motion, full-color video and CD-quality audio at the full NTSC video frame rate of 30 frames per second, with no dropped frames. The card plays the video from a computer file that has been compressed using the MPEG video standard. Hardware playback is typically much better quality than software playback.

There are actually two MPEG standards: MPEG-1 and MPEG-2. A third, MPEG-4, is currently under development. MPEG -1 is a small-picture mode of MPEG geared to a resolution of 352 by 240 pixels at 30 frames per second (U.S.), with full CD-quality audio. MPEG-1 was originally designed to handle much larger picture sizes than 352 by 240 through interpolation or scaling, but MPEG-2 is more efficient. MPEG-2 offers a "main profile at main level" resolution of 720 by 480 pixels at 30 frames per second (U.S.), with full CD-quality audio. This picture size enables full-screen playback on PCs or TVs. MPEG-2 can incorporate a range of compression ratios, which trade off economies of storage and transmission bandwidth against picture quality. At compression ratios of 30:1 and smaller, MPEG-2 offers the perception of broadcast-quality TV. For greater economy, MPEG-2 supports up to 200:1 compression. MPEG-2 decodes such as the IBM decoder chip can also recognize and decode MPEG-1 bitstreams, enabling the IBM chip to support both compression standards.

MPEG-3 has been dropped. It was focused on HDTV with sampling dimensions up to 1,920 by 1,080 at 30 frames per second. The standard was to address bit rates between 20 and 40 Mbit/sec. Nevertheless, it was discovered that with a little tweaking, MPEG-2 and MPEG-1 work extremely well at the HDTV rate. HDTV is now part of the MPEG-2 High-1440 Level specification.

MPEG-4 is currently in the application identification phase, with a target of November 1998 for the official sanction of the proposed standard. Intended for very narrow bandwidths, MPEG-4 is exploring ideas in frame reconstruction. Much like MIDI music creates realistic sound from a narrow bandwidth command string, using pre-existing sound components, MPEG-4 is considering speech and video synthesis, fractal geometry, computer visualization and artificial intelligence to build accurate pictures from minimal data.

If you want to find out even more gory detail about MPEG, hyperlink over to the Moving Pictures Experts Group Web site in Italy at

http://www.crs4.it/~luigi/MPEG/mpegfaq1.html

MPEG-1 See MPEG.

MPEG-2 MPEG-2 is one of the most important standards developed by the Moving Pictures Expert Group, an International Standards Organization (ISO) group responsible for the standardization of coded representations of video and audio signals. MPEG-2 has been chosen as a leading digital video compression for a broad range of future video and broadcast applications. See MPEG and MPEG-2 Audio.

MPEG-2 Audio MPEG-2 audio is a compatible extension

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Tie Line A tie line between two PBX's, permitting ... in one PBX to be connected to extensions in the ... out having to dial through the public switched net- ... also OPX and OPS, which are different and are ... ween PBXs and distant extensions, not tie lines ... PBXs.

Trunk A circuit which connects the PBX to the local ... company's central office switching center or other ... system center.

... onal Computer. See PERSONAL COMPUTER for a ... explanation.

... unt.

... ode.

... Circuit.

... Committee.

... Control.

... ly Correct.

Administration Server A Sun Microsystems term, ... olaris' Server Suite. Automates and centralizes PC ... administration.

As Phone See also HANDSET MANAGEMENT.

Card A memory or I/O card compatible with the PCM- ... Card Standard. In short, PC Cards are a new name for ... A cards. For a much fuller definition, see PCMCIA, ... stands for the Personal Computer Memory Card ... ional Association.

Centric There are two ways you can organize a comput- ... control telephone calls on an office telephone system ... is to join a file server on a local area network to a ... system. Commands to move calls around are passed ... the desktop PC over the LAN to the server and then to ... system via the cable connection between the serv- ... the system. A second way to get a computer to control ... calls is through a connection at the desktop. This is ... PC Centric. There are two ways you can do this. The ... to join the desktop phone to the computer with a cable. ... often done via the PC's serial port connecting via cable ... phone's data communications port (if it has one — if it ... you get one). The second way to be PC Centric is by ... replacing the standalone phone with a board that emu- ... a phone and drop it into the PC's bus.

DOS What IBM calls a version of the operating system on ... personal computers. It PC-DOS runs on an IBM ... ible, it is called MS-DOS, which stands for MicroSoft ... Operating System. Microsoft of Bellevue, Washington, ... MS DOS and PC-DOS.

Network IBM's first LAN (Local Area Network).

Telephony Another term for Computer Telephony. See ... UTER TELEPHONY.

... the plural of the word PC, according to the New York ... However, every other computer and general magazine ... PCs. And that's the spelling which this dictionary ... prefers also.

... Premises Cabling Association. A association in ... ...

... Connecting Arrangement. A device that AT&T ... members of the Bell System insisted be connected ... a telecommunications device (like a phone) that ... made and sold by AT&T and a phone line provided by ... Bell operating company. Many years later, the PCAs ... by the FCC to be totally unnecessary and AT&T ... of the Bell System were ordered to refund all ... received for rental of PCAs. The Bell System insist- ... PCAs as a way of protecting AT&T's effective monopoly of telecommunications equipment. See also PROTECTIVE CONNECTIVE ARRANGEMENT.

PCB Printed Circuit Board.

PCC Personal Companion Computer. What other companies call a PDA (Personal Digital Assistant), Intel calls a PCC. A PCC or PDA is meant to have significant telecommunications abilities — including wired and wireless. See PDA.

PCCA AT Command Set The new PCCA AT command set for wireless modems contains well-defined commands for obtaining link status information.

PCF Physical Control Fields. The AC (Access Control) and FC (Frame Control) bytes in a Token Ring header.

PCH Paging CHannel. Specified in IS-136, PCH carries signaling information for set up and delivery of paging messages from the cell site to the user terminal equipment. PCH is a logical subchannel of SPACH (SMS (Short Message Service) point-to-point messaging, Paging, and Access response CHannel), which is a logical channel of the DCCH (Digital Control CHannel), a signaling and control channel which is employed in cellular systems based on TDMA (Time Division Multiple Access). The DCCH operates on a set of frequencies separate from those used to support cellular conversations. See also DCCH, IS-136, PAGING, SPACH and TDMA.

PCI 1. Protocol Control Information. The protocol information added by an OSI entity to the service data unit passed down from the layer above, all together forming a Protocol Data Unit (PDU).

2.Peripheral Component Interconnect, a 32 bit local bus inside a PC or a Mac designed by Intel for the PC. According to Intel, it can transfer data between the PC's main microprocessor (its CPU) and peripherals (hard disks, video adapters, etc.) at up to 132 megabytes per second, compared to only five megabytes per second which the original PC's ISA bus is capable of. PCI is one of two widely adopted local-bus standards. The other, the VL-Bus, is primarily used in 486 PCs. See also CompactPCI and VLB.

PCIA Personal Communications Industry Association. The association of the new cellular providers.

PCL 1. Hewlett-Packard's Printer Control Language, developed by HP in 1984 as a way for the then-new PC to communicate with a new breed of laser printers — the HP LaserJet printer. HP's PCL language is now the de facto industry standard for PC printing. Most of the printers in the world today are equipped with PCL or a PCL-compatible language. PCL allows the type of sophisticated page creation generally referred to as "laser quality output." PCL supports such advanced features as fully scalable typefaces and rotation of text. PCL defines a standard set of commands enabling applications to communicate with HP or HP-compatible printers. PCL has become a de facto standard for laser and ink jet printers and is supported by virtually all printer manufacturers. On April 8, 1996 HP announced PCL 6 which it billed as "the next generation" of HP Printer Control Language). HP said that PCL 6 includes font synthesis technology for true what-you-see-is-what-you-get (WYSIWYG) printing and better document fidelity. PCL 6 commands were designed by HP to closely match Microsoft Windows GDI (Graphical Direct Interface) commands.

2. Product Compute-Module Load.

PCM Pulse Code Modulation. The most common method of encoding an analog voice signal into a digital bit stream. First, the amplitude of the voice conversation is sampled. This is called PAM, Pulse Amplitude Modulation. This PAM sample is then coded (quantized) into a binary (digital) number. This digital number consists of zeros and ones. The voice sig-

High-definition television

From Wikipedia, the free encyclopedia

High-definition television (HDTV) is a digital television broadcasting system with greater resolution than traditional television systems (NTSC, SECAM, PAL). HDTV is digitally broadcast, because digital television (DTV) requires less bandwidth if sufficient video compression is used. HDTV technology was introduced in the United States in the 1990s by the Digital HDTV Grand Alliance, a group of television companies.[1][2]

Projection screen in a home theater, displaying a high-definition television image.

Contents

History of high-definition television

In 1949, France launched 819 lines television, first high definition public television network (778 active lines). This 819 lines network remained operational until 1983.

In 1958, the U.S.S.R created *Трансформатор* (Transformer), the first high-resolution (definition) television system capable of producing an image composed of 1,125 lines of resolution for the purpose of television conferences among military commands; as it was a military product, it was not commercialised.[3]

In 1969, Nippon Hōsō Kyōkai (NHK) first developed commercial, high-definition television, [4] yet, the system was not commercialized until late in the 1990s.

In 1983, the International Telecommunication Union ITU-R set up a working party (IWP11/6) with the aim of setting a single international HDTV standard. This WP considered many views and through the 1980s served to encourage development in a number of video digital processing areas such as conversion between 30/60 and 25/50 picture rates using motion vectors that led to other outcomes. While a single standard was never finalized, a common aspect ratio of 16:9 was agreed to at the first meeting at the BBC's R & D establishment at Kingswood Warren. Initially the Japanese 5:3 ratio was considered but a proposal to widen it to 5 1/3:3 = 16:9 was accepted. The ITU-R Recommendation BT.709 includes 16:9, colorimetry and the 1080i (1,080 actively-interlaced lines of resolution) and the 1080p (1,080 progressively-scanned lines). It also included the 1440 x 1152 HDMAC scanning format. 720p formats were strongly resisted by some ITU-R members and were not standardized there. Both 1920 x 1080 and 1280 x 720p (720 progressively-scanned lines) systems for a range of frame and field rates are also defined by several SMPTE standards.

No matter how hard developers tried, and despite the over 20 different standards proposed, high definition television lacked the basics of any successful media application; that is the means of distributing it.

Early HDTV commercial experiments such as NHK's MUSE required over four times the bandwidth of a standard definition broadcast, and despite the effort made to shrink the required bandwidth into about 2 times of that of the SDTV's, it still was distributable only by satellite. In addition, recording and reproducing an HDTV signal was also a technical challenge in the early years of HDTV. Nevertheless, the first HDTV sets went on sale in the United States in 1998. However, it was not until the first decade of the new millennium that storage means of enough capacity and computer processing power for dense compression algorithms made commercial applications of HDTV affordable for consumers and profitable for TV channels or the video rental industry.

Digital HDTV was finally viable due to the evolution of TV broadcasting, where the broadcasting systems all over the world were designed from scratch to use digital means of transmission. Thus, through digital compression equipment, and the evolution of standards such as MPEG 2, H264, a single TV channel could be used either for broadcasting up to 5 TV programs of standard definition, or for broadcasting up to 2 channels of high definition.

High-definition television refers to the image resolution and, loosely, to photo- and videographic media

capable of such image resolution, i.e. photographic film and digital video. Current HDTV broadcast standards are in the ATSC and DVB specifications. HDTV is capable of cinema-quality audio, because it uses the Dolby Digital (AC-3) format to support the 5.1 surround sound system.

"The FCC currently has a February 17, 2009, deadline for the transition to all digital broadcasting. On this date, all analog broadcasting will stop, and consumers will need to buy converter boxes to receive programming on their older TVs. This deadline has been pushed back several times in the last few years because of both broadcasters' and consumers' inability to meet the FCC's criteria for a successful transition to digital broadcasting. TV stations must have the equipment to send digital broadcasts, and consumers must have the TVs to receive them."[5]

HDTV sources

The rise in popularity of large screens and projectors has made the limitations of conventional Standard Definition TV (SDTV) increasingly evident. An HDTV compatible television set will not improve the quality of SDTV channels. To display a superior picture, high definition televisions require a High Definition (HD) signal. Typical sources of HD signals are as follows:

- Over the air with an antenna. Most cities in the US with major network affiliates broadcast over the air in HD. To receive this signal an HD tuner is required. Most newer high definition televisions have an HD tuner built in. For HDTV televisions without a built in HD tuner, a separate set-top HD tuner box can be rented from a cable or satellite company or purchased.
- Cable television companies often offer HDTV broadcasts as part of their digital broadcast service. This is usually done with a set-top box or CableCARD issued by the cable company. Alternatively one can usually get the network HDTV channels for free with basic cable by using a QAM tuner built into their HDTV or set-top box. Some cable carriers also offer HDTV on-demand playback of movies and commonly viewed shows.
- Satellite-based TV companies, such as DirecTV and Dish Network (both in North America), Sky Digital (in the UK and Ireland), Bell ExpressVu (in Canada) and NTV Plus (in Russia), offer HDTV to customers as an upgrade. New satellite receiver boxes and a new satellite dish are often required to receive HD content.
- Video game systems, such as the Xbox (NTSC only), Xbox 360, Playstation 2 (Gran Turismo 4) and Playstation 3 can output an HD signal. The Xbox Live Marketplace and Playstation Network services offers HD movies, TV shows, movie trailers, and clips for download to their respective consoles.
- Most newer computer graphics cards have either HDMI or DVI interfaces, which can be used to output images or video to an HDTV.
- Two optical disc standards, Blu-ray Disc and HD DVD, can provide enough digital storage to store hours of HD video content.DVDs look best on screens that are smaller than 36 inches, so they're not always up to the challenge of today's high-definition (HD) sets. To store and play HD movies, you need a disc that holds more information, like an HD-DVD. The basic idea behind the HD-DVD is really simple: A DVD holds about two hours of standard definition video, but an HD-DVD can hold about 48 hours.[6]

Notation

HDTV broadcast systems are defined threefold, by:

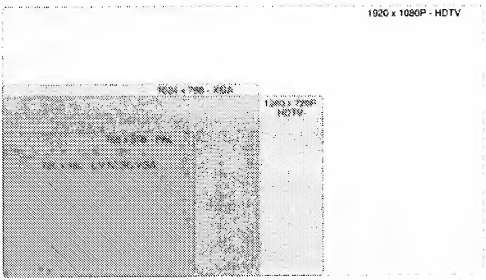
- The number of lines in the vertical display resolution.
- The scanning system: progressive scanning (p) or interlaced scanning (i). *Progressive scanning* redraws an image frame (all of its lines) when refreshing each image. *Interlaced scanning* redraws the image field (every second line) per each image refresh operation, and then redraws the remaining lines during a second refreshing. Interlaced scanning yields greater image resolution if subject is not moving, but loses up to half of the resolution and suffers "combing" artifacts when subject is moving.
- The number of frames per second or fields per second.

The 720p60 format is 1280 × 720 pixels, progressive encoding with 60 frames per second (60 Hz). The 1080i50 format is 1920 × 1080 pixels, interlaced encoding with 50 fields per second. Sometimes interlaced fields are called half-frames, but they are not, because two fields of one frame are temporally shifted. Frame pulldown and segmented frames are special techniques that allow transmitting full frames by means of interlaced video stream.

For commercial naming of the product, either the frame rate or the field rate is dropped, e.g. a "1080i television set" label indicates only the image resolution.[7] Often, the rate is inferred from the context, usually assumed to be either 50 or 60, except for 1080p, which denotes 1080p24, 1080p25, and 1080p30, but also 1080p50 and 1080p60 in the future.

A frame or field rate can also be specified without a resolution. For example 24p means 24 progressive scan frames per second and 50i means 25 interlaced frames per second, consisting of 50 interlaced fields per second. Most HDTV systems support some standard resolutions and frame or field rates. The most common are noted below.

Standard Display Resolutions



Video Format (WxH)	Name	Description
720×576	576i	Used on D1/DV PAL

Video Format (WxH)	Name	Description
720×576	576i	Used on D1/DV PAL
704×576	576p	Used on EDTV PAL
720×480	480i	Used on DV NTSC
720×486	480i	Used on D1 NTSC (ITU-R 601)
704×480	480p	Used on EDTV NTSC

When resolution is considered, both the resolution of the transmitted signal and the (native) displayed resolution of a TV set are taken into account. Digital NTSC- and PAL/SECAM-like signals (480i60 and 576i50 respectively) are transmitted at a horizontal resolution of 720 or 704 "pixels".

However these transmitted DTV "pixels" are not square, and have to be stretched for correct viewing. PAL TV sets with an aspect ratio of 4:3 use a fixed pixel grid of 768 × 576 or 720 × 540; with an aspect ratio of 16:9 they use 1440 x 768, 1024 × 576 or 960 × 540; NTSC ones use 640 × 480 and 852 × 480 or, seldom, 720 × 540.

High-Definition Display Resolutions

High Definition usually refers to 720 vertical lines of resolution or more.

Resolution (WxH)	Pixels	Aspect Ratio	Video Format	Description
1024×768	786,432	16:9 (non-square pixels)	720p/XGA	Used on PDP HDTV displays with non square pixels
1280×720	921,600	16:9	720p/WXGA	Used on Digital television, DLP, LCD and LCOS projection HDTV displays
1366×768	1,049,088	16:9	720p/WXGA - HDTV standard format	Used on LCD/PDP HDTV displays (HD Ready, HD Ready 720p,1080i)
1024×1080	1,105,920	16:9 (non-square pixels)	1080p	Used on PDP HDTV displays (Full HD, HD Ready 1080p)
1280×1080	1,382,400	16:9 (non-square pixels)	1080p	Used on PDP HDTV displays (Full HD, HD Ready 1080p)
1920×1080	2,073,600	16:9	1080p - HDTV standard format	Used on all types of HDTV technologies (Full HD, HD Ready 1080p)
4096x2160	8,847,360	16:9	2160p DCI Cinnema 4k standard format	Quad HDTV, (there is no HD Ready 2160p Quad HDTV format)

A common resolution used in HD Ready LCD TV panels is 1366 x 768[8] pixels instead of the ATSC Standard 1280 x 720 pixels. This is due to maximization of manufacturing yield and resolution of VGA, VRAM that comes with a 768 pixel format. Hence, LCD manufacturers adopt the 16:9 ratio compatible for the HD Ready 1080p standard. Nevertheless, every HDTV has an overscan processing chipset to fix resolution scaling and color rendering, eg LG XD Engine, SONY BRAVIA Engine. Only when viewing 1080i/1080p HD contents under HD Ready 1080p where there is true pixel-for-pixel reproduction, and for HD ready LCD TV, do some signals undergo a scaling process which results in a 3-5% loss of picture.

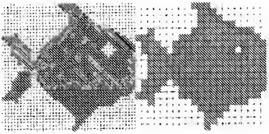
Standard frame or field rates

- 23.976p (allow easy conversion to NTSC)
- 24p (cinematic film)
- 25p (PAL, SECAM DTV progressive material)
- 30p (29.97p in drop frame) (NTSC DTV progressive material)
- 50p (PAL, SECAM DTV progressive material)
- 60p (59.94p in drop frame) (NTSC DTV progressive material)
- 50i (PAL & SECAM)
- 60i (59.94i in drop frame) (NTSC, PAL-M)

Broadcast station format considerations

At the least, HDTV has twice the linear resolution of standard-definition television (SDTV), thus showing greater detail than either analog television or regular DVD. The technical standards for broadcasting HDTV also handle the 16:9 aspect ratio images without using letterboxing or anamorphic stretching, thus increasing the effective image resolution.

Close-up view



HDTV resolution SDTV resolution

The optimum format for a broadcast depends upon the type of videographic recording medium used and the image's characteristics. The field and frame rate should match the source and the resolution. A very high resolution source may require more bandwidth than available in order to be transmitted without loss of fidelity. The lossy compression that is used in all digital HDTV storage and transmission systems will distort the received picture, when compared to the uncompressed source.

Types of medium

The high resolution photographic film used for cinema projection is exposed at the rate of 24 frames per second. Depending upon available bandwidth and the amount of detail and movement in the image, the optimum format for video transfer is either 720p24 or 1080p24. When shown on television in PAL system countries, film must be projected at the rate of 25 frames per second by accelerating it by 4.1 per cent. In NTSC standard countries, the projection rate is 30 frames per second, a using a technique called 3:2 pull-down. One film frame is held for three video fields (1/20 of a second), and the next is held for two video fields (1/30 of a second) and then the process is repeated, thus achieving the correct film projection rate with two film frames shown in 1/12 of a second. Template:Cf.

Older (pre-HDTV) recordings on video tape such as Betacam SP are often either in the form 480i60 or 576i50. These may be upconverted to a higher resolution format (720i), but removing the interlace to match the common 720p format may distort the picture or require filtering which actually reduces the resolution of the final output.

See also: Deinterlacing

Non-cinematic HDTV video recordings are recorded in either the 720p or the 1080i format. The format used is set by the broadcaster (if for television broadcast). In general, 720p is more accurate with fast action, because it progressively scans frames, instead of the 1080i, which uses interlaced fields and thus might degrade the resolution of fast images.

720p is used more for Internet distribution of high-definition video, because computer monitors progressively scan; 720p video has lower storage-decoding requirements than either the 1080i or the 1080p.This is also the medium for High - Definition Broadcasts around the Globe(Earth) and 1080p is used for Blue-ray movies and the much less popular HdDvd.

List of stations

- In Australia, the 576p50 format is also considered a HDTV format, as it has higher vertical resolution through the use of progressive scanning. When Australia started DVB-T in 2001 several networks broadcast high-definition in a 576p format as this could give better quality on 50Hz scanning CRT TVs and was not as demanding on MPEG-2 bit-rate. Now that flat-screens are predominating and these have an interlace to progressive scan conversion there is little difference in picture quality. Also MPEG-2 encoders have improved so the more conventional 720p and 1080i formats are now used. Technically, the 576p format is internationally defined as Enhanced-definition television and many DVD players can provide a 576p signal usually on HDMI outputs.

- In North America, Fox, My Network TV (both owned by the News Corporation), ABC, and ESPN (ABC and ESPN are both owned by Disney) currently broadcast 720p content. NBC, Universal HD (both owned by the NBC Universal subsidiary of General Electric and Vivendi), CBS, The CW (co-owned by CBS and Time Warner), HBO (owned by Time Warner), Showtime (owned by CBS), Starz!, MOJO HD, HDNet ,TNT(owned by Time Warner), CNN (also owned by Time Warner), and Discovery HD Theater currently broadcast 1080i content. In Canada, virtually all over-the-air HD stations broadcast 1080i, as do most cable specialty channels.

- In Singapore, MediaCorp TV HD5 is Singapore's first over-the-air HDTV channel, simulcasting HD version of Channel 5 programming in 1080i. It is the first terrestrial broadcast HD channel in South-East Asia and also first in the world to use MPEG4/AVC compression.[9]

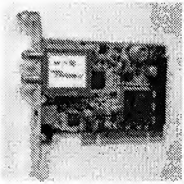
- In the United Kingdom on Sky Digital, there are BBC HD, Sky One HD, Sky Arts HD, Sky Movies HD1 & 2, Sky Sports HD1,2 & X, Discovery HD, National Geographic Channel HD, The History Channel HD & Sky Box Office HD1 & 2. With MTV HD, FX HD, Living HD Rush HD, Ultra HD & Eurosport HD to come in the near future. BBC HD is also available on Virgin Media. The BBC Trust has given provisional approval for a BBC HD channel, which would be broadcast satellite, cable and DTT.
  - Public consultation on the Trust's provisional conclusions on the proposed BBC HD service

(http://www.bbc.co.uk/bbctrust/consult/open_consultations/hdtv_consult.html) is open until 23 October 2007.

- In Brazil all 5 major TV networks (Band, Rede Globo, Rede Record, RedeTV! and SBT) and the public television started to broadcast HDTV (1080i) in December 2007. Brazil uses a mixture of the japanese HDTV system with Brazilian tecnology called SBTVD.

Technical details

MPEG-2 is most commonly used as the compression codec for digital HDTV broadcasts. Although MPEG-2 supports up to 4:2:2 YCbCr chroma subsampling and 10-bit quantization, HD broadcasts use 4:2:0 and 8-bit quantization to save bandwidth. Some broadcasters also plan to use MPEG-4 AVC, such as the BBC which is trialing such a system via satellite broadcast, which will save considerable bandwidth compared to MPEG-2 systems. Some German broadcasters already use MPEG-4 AVC together with DVB-S2 (Pro 7, Sat.1 and Premiere). Although MPEG-2 is more widely used at present, it seems likely that in the future all European HDTV may be MPEG-4 AVC, and Norway, which is currently in the progress of implementing digital television broadcasts, is using MPEG-4 AVC for present SD Digital as well as for future HDTV on terrestrial broadcasts. In parts of Sweden the standard is already in use for HDTV terrestrial broadcasting, reaching about 25-30% of the population.



One of the first DVB-S2 tuner cards.

HDTV is capable of "theater-quality" audio because it uses the Dolby Digital (AC-3) format to support "5.1" surround sound. The pixel aspect ratio of native HD signals is a "square" 1.0, in which each pixel's height equals its width. New HD compression and recording formats such as HDV use rectangular pixels to save bandwidth and to open HDTV acquisition for the consumer market. For more technical details see the articles on HDV, ATSC, DVB, and ISDB.

Television studios as well as production and distribution facilities, use HD-SDI SMPTE 292M interconnect standard (a nominally 1.485 Gbit/s, 75-ohm serial digital interface) to route uncompressed HDTV signals. The native bitrate of HDTV formats cannot be supported by 6-8 MHz standard-definition television channels for over-the-air broadcast and consumer distribution media, hence the widespread use of compression in consumer applications. SMPTE 292M interconnects are generally unavailable in consumer equipment, partially due to the expense involved in supporting this format, and partially because consumer electronics manufacturers are required (typically by licensing agreements) to provide encrypted digital outputs on consumer video equipment, for fear that this would aggravate the issue of video piracy.

Newer dual-link HD-SDI signals are needed for the latest 4:4:4 camera systems (Sony Cinealta F23 & Thomson Viper), where one link/coax cable contains the 4:2:2 YCbCr info and the other link/coax cable contains the additional 0:2:2 CbCr information.

Advantages of HDTV expressed in non-technical terms

High-definition television (HDTV) yields a better-quality image than does standard television, because

it has a greater number of lines of resolution. Because the signal is a digital signal, it produces neither a snowy nor pale image from a weak signal or signal interference effects, such as herringbone patterns, or vertical rolling. Image colours are more realistic, because of the greater bandwidth. The visual information is some 2-5 times sharper because the gaps between the scan lines are narrower or invisible to the naked eye. Television content photographed and preserved on 35 mm film can be viewed at nearly its original resolution.

The lower-case "i" appended to the numbers denotes *interlaced*; the lower-case "p" denotes *progressive*. The interlaced scanning method, the 1,080 lines of resolution are divided into two, the first 540 lines are painted on a frame, the second 540 lines are painted on a second frame, reducing the bandwidth and increasing frame rate to 50-60 frames per second. The progressive scanning method simultaneously displays all 1,080 lines of resolution at 60 frames per second, on a greater bandwidth. (*See:* An explanation of HDTV numbers (http://www.pcworld.ca/Pages/NewsColumn.aspx?id=c0bcc80f0a01040800b24c9ac8d058ee) and laymen's glossary (http://www.pcworld.ca/Pages/NewsColumn.aspx?id=a419bea40a010408019ac931bd202fb7))

Often, the broadcast HDTV video signal soundtrack is Dolby Digital 5.1 surround sound, enabling full, surround sound capabilities, while STBC television signals include either monophonic or stereophonic audio, or both. Stereophonic broadcasts can be encoded with Dolby Surround audio signal.

Disadvantages of HDTV expressed in non-technical terms

In practice, the best possible HD quality is not usually achieved. The main problem is that many operators do not follow HDTV specifications fully. They may use slower bitrates or lower resolution to pack more channels within the limited bandwidth.[10] The operators may use format that is different from the original programming, introducing generation loss artifacts in the process of re-encoding.[11] Also, image quality may be lost if the television is not properly connected to the input device or not properly configured for the input's optimal performance, which may be difficult because of customer confusion regarding connections.

As high-definition video broadcasts are digital, the disadvantages of digital video broadcasting also apply here. For example, digital video responds differently to analogue video when subject to interference. As opposed to a lower-quality signal one gets from interference in an analogue television broadcast, interference in a digital television broadcast will freeze, skip, or display "garbage" information. Broadcasters may aggressively compress video to save bandwidth and therefore broadcast more channels - this compression manifests itself as reduced video quality.

In order to view HDTV broadcasts, viewers may have to upgrade their TVs, incurring household expense in the process. Adding a new aspect ratio makes for consumer confusion if their display is capable of one or more ratios but must be switched to the correct one by the user. Traditional standard definition TV shows and feature films (mostly movies from before 1953) originally filmed in the standard 4:3 ratio, when displayed correctly on an HDTV monitor, will have empty display areas to the left and right of the image. Many consumers aren't satisfied with this unused display area and choose instead to distort their standard definition shows by stretching them horizontally to fill the screen, giving everything a too-wide or not-tall-enough appearance. Alternately, they'll choose to zoom the image which removes content that was on the top and bottom of the original TV show.[12]

As of 2007, broadcasters may demand, or cable-television operators may elect, to place HD signals in a

premium band that requires higher cable fees. That some satellite companies offer the local HD channels as a service at additional cost (transmission comes from satellite) suggests to some broadcasters that on-air broadcasts of local HD signals must be a premium service to subscribers. Viewers may be denied some television channels that they expected, be allowed only access to the non-digital, and obviously sub-standard non-digital signal, or have to install an antenna to receive the digital broadcasts. Such issues more entail economic and legal disputes than they entail technology.

Another disadvantage of HDTV compared to traditional television has been consumer confusion stemming from the different standards and resolutions, such as 1080i, 1080p, and 720p. Complicating the matter have been the changes in television connections from component video, to DVI, then to HDMI. Finally, the HD-DVD vs. Blu-ray Disc high definition storage format war engenders even more animosity for consumers. The confusion has led to slower uptake of the technology as many people wait to see what becomes the "ultimate" de-facto standard.

Early systems

The term *high definition* described the television systems of the 1930s and 1940s beginning with the British 405-line black-and-white system, introduced in 1936; however, it and the American 525-line NTSC system established in 1941, were high definition in comparison with previous mechanical and electronic television systems. Today, the American 525-line NTSC system and the European 625-line PAL and SECAM systems are standard definition television, whereas the post–WWII French 819-line black-and-white system, was high definition in the contemporary sense, it required more bandwidth and was discontinued in 1986, a year after the final British 405-line broadcast.

Japan is the only country with successful commercial analog HDTV, known as "Hi-vision", featuring a 5:3 aspect ratio screen with 1,125 interlaced lines (1,035 active lines) at the rate of 60 fields per second. Elsewhere, in Europe, analog 1,125-line HD-MAC television failed in its test broadcasts in the early 1990s.

Contemporary systems

Besides an HD-ready television set, other equipment is needed to view HD television. Cable-ready TV sets can display HD content without using an external box. They have a card slot for inserting a CableCARD.[13].

High-definition image sources include terrestrial broadcast, direct broadcast satellite, digital cable, high definition discs (BD and HD DVD), internet downloads and the latest generation of video game consoles.

Recording and compression

HDTV can be recorded to D-VHS (Data-VHS), W-VHS (analog only), to a HDTV-capable digital video recorder (for example DirecTV's high-definition Digital video recorder, Sky HD's set-top box, Dish Network's VIP 622 or VIP 722 high-definition

Components of a typical satellite HDTV system:
1. HDTV Monitor
2. HD satellite receiver
3. Standard satellite dish

4. HDMI cable, DVI-D and audio cables, or audio and component video cables

Digital video recorder receivers, or TiVo's Series 3 or HD recorders), or an HDTV-ready HTPC. Some cable boxes are capable of receiving or recording two broadcasts at a time in HDTV format, and HDTV programming, some free, some for a fee, can be played back with the cable company's on-demand feature. The massive amount of data storage required to archive uncompressed streams make it unlikely that an uncompressed storage option will appear in the consumer market soon. Realtime MPEG-2 compression of an uncompressed digital HDTV signal is also prohibitively expensive for the consumer market at this time, but should become inexpensive within several years (although this is more relevant for consumer HD camcorders than recording HDTV). Analog tape recorders with bandwidth capable of recording analog HD signals such as W-VHS recorders are no longer produced for the consumer market and are both expensive and scarce in the secondary market.

In the United States, as part of the FCC's "plug and play" agreement, cable companies are required to provide customers that rent HD set-top boxes with a set-top box with "functional" Firewire (IEEE 1394) upon request. None of the direct broadcast satellite providers have offered this feature on any of their supported boxes, but some cable TV companies have. As of July 2004, boxes are not included in the FCC mandate. This content is protected by encryption known as 5C.[14] This encryption can prevent duplication of content or simply limit the number of copies permitted, thus effectively denying most if not all fair use of the content.

Table of terrestrial HDTV transmission systems

Main characteristics of three DTTV systems

Systems	ATSC	DVB-T	ISDB-T
Source coding			
Video	Main Profile syntax of ISO/IEC 13818-2 (MPEG-2 – Video)		
Audio	ATSC Standard A/52 (Dolby AC-3)	As defined in ETSI DVB TS 101 154 - as H.264 AVC and/or ISO/IEC 13818-2 (MPEG-2 – Layer II Audio) and/or Dolby AC-3	ISO/IEC 13818-7 (MPEG-2 – AAC Audio)
Transmission system			
Channel coding			
Outer coding	R-S (207, 187, t = 10)	R-S (204, 188, t = 8)	
Outer interleaver	52 R-S block	convolutional (I=12, M=17, J=1)	12 R-S block
Inner coding	rate 2/3 Trellis code	PCC: rate 1/2, 2/3, 3/4, 5/6, 7/8; constraint length = 7, Polynomials (octal) = 171, 133	
Inner interleaver	12 to 1 Trellis code	bit-wise, frequency, selectable time	
Data randomization	16-bit PRBS		

Modulation	8VSB (Only used for over the air transmission) 16VSB (Designed for cable, but rejected by the cable industry, cable TV uses 64QAM or 256QAM modulation as a de facto standard)	COFDM QPSK, 16QAM and 64QAM Hierarchical modulation: multi-resolution constellation (16QAM and 64QAM) Guard interval: 1/32, 1/16, 1/8 & 1/4 of OFDM symbol Two modes: 2k and 8k FFT	BST-COFDM with 13 frequency segments DQPSK, QPSK, 16QAM and 64QAM Hierarchical modulation: choice of three different modulations on each segment Guard interval: 1/32, 1/16, 1/8 & 1/4 of OFDM symbol Three modes: 2k, 4k and 8k FFT

TV resolution

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11. ^ DirecTV's HD future is MPEG-4 (http://www.pcmag.com/print_article2/0,1217,a=142168,00.asp).
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- United States Federal Standard 1037C
- DTV channel protection ratios
- DVB HDTV standard
- Images formats for HDTV (http://www.ebu.ch/en/technical/trev/trev_299-ive.pdf), article from the EBU Technical Review .
- High Definition for Europe - a progressive approach (http://www.ebu.ch/en/technical/trev/trev_300-wood.pdf), article from the EBU Technical Review .
- High Definition (HD) Image Formats for Television Production

(http://www.ebu.ch/CMSimages/en/tec_doc_t3299_tcm6-23327.pdf), technical report from the EBU

- TV Azteca Plans HDTV Mexican Rollout (http://www.worldscreen.com/archivenews4.php?filename=harris421.htm)_tcm

See also

- 480p, 576p, 720p, 1080i, 1080p
- Advanced Television Systems Committee (ATSC)
- ATSC tuner
- Integrated Services Digital Broadcasting
- DVB (Digital Video Broadcasting)
- Digital television
- HDTV input and colorspace (YPbPr/YCbCr).
- HD ready
- SDTV (Standard Definition Television)
- Ultra-High Definition Video (UHDV)
- High-definition television in the United Kingdom
- Freesat
- High-definition television in the United States
- HDTV Blur

External links

- US Government HDTV and DTV official site (http://www.dtv.gov/)
- Canadian Radio-television and Telecommunications Commission (http://www.crtc.gc.ca/)
- CEA'S HDTV Guide (http://www.ce.org/Press/CEA_Pubs/821.asp)

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Non-linear editing system

From Wikipedia, the free encyclopedia

"NLE" redirects here. For the standardized test, see National Latin Examination.

A **non-linear editing system** (**NLE**) is a video editing (NLVE) or audio editing (NLAE) system which can perform random access on the source material.

Contents

Non-linear editing

Non-linear editing for film and television postproduction is a modern editing method which involves being able to access any frame in a video clip with the same ease as any other. This method is similar in concept to the "cut and paste" technique used in film editing from the beginning. However, when working with film, it is a destructive process, as the actual film negative must be cut. Non-linear, non-destructive methods began to appear with the introduction of digital video technology.

Video and audio data are first captured to hard disks or other digital storage devices. The data is either recorded directly to the storage device or is imported from another source. Once imported they can be edited on a computer using any of a wide range of software. For a comprehensive list of available software, see List of video editing software, whereas Comparison of video editing software gives more detail of features and functionality.

In non-linear editing, the original source files are not lost or modified during editing. Professional editing software records the decisions of the editor in an edit decision list (EDL) which can be interchanged with other editing tools. Many generations and variations of the original source files can exist without needing to store many different copies, allowing for very flexible editing. It also makes it easy to change cuts and undo previous decisions simply by editing the edit decision list (without having to have the actual film data duplicated). Loss of quality is also avoided due to not having to repeatedly re-encode the data when different effects are applied.

Compared to the linear method of tape-to-tape editing, non-linear editing offers the flexibility of film editing, with random access and easy project organization. With the edit decision lists, the editor can work on low-resolution copies of the video. This makes it possible to edit both standard-definition broadcast quality and high definition broadcast quality very quickly on normal PCs which do not have the power to do the full processing of the huge full-quality high-resolution data in real-time.

The costs of editing systems have dropped such that non-linear editing tools are now within the reach of home users. Some editing software can now be accessed free as web applications, some, like Cinelerra

(focused on the professional market), can be downloaded free of charge, and some, like Microsoft's Windows Movie Maker or Apple Computer's iMovie, come included with the appropriate operating system.

A computer for non-linear editing of video will usually have a video capture card for capturing analog video and/or a FireWire connection for capturing digital video from a DV camera, as well as video editing software. Modern web based editing systems can take video directly from a camera phone over a GPRS or 3G mobile connection, and editing can take place through a web browser interface, so strictly speaking a computer for video editing does not require any installed hardware or software beyond a web browser and an internet connection.

Various editing tasks can then be performed on the imported video before it is exported to another medium, or MPEG encoded for transfer to a DVD.

History

The first truly non-linear editor, the CMX 600, was introduced in 1971 by CMX Systems, a joint venture between CBS and Memorex. It recorded & played back black-and-white analog video recorded in "skip-field" mode on modified disk pack drives the size of washing machines. These were commonly used to store data digitally on mainframe computers of the time. The 600 had a console with 2 monitors built in. The right monitor, which played the preview video, was used by the editor to make cuts and edit decisions using a light pen. The editor selected from options which were superimposed as text over the preview video. The left monitor was used to display the edited video. A Digital PDP-11 computer served as a controller for the whole system. Because the video edited on the 600 was in black and white and in low-resolution "skip-field" mode, the 600 was suitable only for offline editing.

Various approximations of non-linear editing systems were built in the '80s using computers coordinating multiple laser discs, or banks of VCRs. One example of these tape & disc-based systems was Lucasfilm's EditDroid, which used several laserdiscs of the same raw footage to simulate random-access editing (a compatible system was developed for sound post production by Lucasfilm called SoundDroid--one of the earliest digital audio workstations).

The term "nonlinear editing" or "non-linear editing" was formalized in 1991 with the publication of Michael Rubin's "Nonlinear: a handbook for electronic film and video editing" (Triad, 1991) -- which popularized this terminology over other language common at the time, including "real time" editing, "random-access" or "RA" editing, "virtual" editing, "electronic film" editing, and so on. The handbook has remained in print since 1991, currently in its 4th edition (Triad, 2000).

Computer processing advanced sufficiently by the end of the '80s to enable true digital imagery, and has progressed today to provide this capability in personal desktop computers.

An example of computing power progressing to make non-linear editing possible was demonstrated in the first all-digital non-linear editing system to be released, the "Harry" effects compositing system manufactured by Quantel in 1985. Although it was more of a video effects system, it had some non-linear editing capabilities. Most importantly, it could record (and apply effects to) 80 seconds (due to hard disk space limitations) of broadcast-quality uncompressed digital video encoded in 8-bit CCIR 601 format on its built-in hard disk array.

Non-linear editing with computers as we know it today was first introduced by Editing Machines Corp. in 1989 with the EMC2 editor; a hard disk based non-linear off-line editing system, using half-screen resolution video at 15 frames per second. A couple of weeks later that same year, Avid introduced the Avid/1, the first in the line of their Media Composer systems. It was based on the Apple Macintosh computer platform (Macintosh II systems were used) with special hardware and software developed and installed by Avid. The Avid/1 was not the first system to introduce modern concepts in non-linear editing, however, such as timeline editing and clip bins -- both of which were pioneered in Lucasfilm's EditDroid in the early 1980s.

The video quality of the Avid/1 (and later Media Composer systems from the late 80s) was somewhat low (about VHS quality), due to the use of a very early version of a Motion JPEG (M-JPEG) codec. But it was enough to be a very versatile system for offline editing, to revolutionize video and film editing, and quickly become the dominant NLE platform.

In October 1990 NewTek introduced Video Toaster, a hardware and software solution for the Commodore Amiga 2000 computer system, taking advantage of the video-friendly aspects of that system's hardware to deliver the product at an unusually low cost ($1499). The hardware component was a full-sized card which went into the Amiga's unique single video expansion slot rather than the standard bus slots, and therefore could not be used with the A500 and A1000 models. The card had several BNC connectors in the rear, which accepted four video input sources and provided two outputs (preview and program). This initial generation system was essentially a real-time four-channel video switcher.

For the second generation NewTek introduced the **Video Toaster Flyer**. The Flyer was a much more capable Non-linear editing system. In addition to just processing live video signals, the Flyer made use of hard drives to store video clips as well as audio and allow complex scripted playback. The Flyer was capable of simultaneous dual-channel playback, which allowed the Toaster's Video switcher to perform transitions and other effects on Video clips without the need for rendering.

The hardware component was again a card designed for the Amiga's Zorro 2 expansion slot, and was primarily designed by Charles Steinkuehler. The Flyer portion of the Video Toaster/Flyer combination was a complete computer of its own, having its own Microprocessor and Embedded software, which was written by Marty Flickinger. Its hardware included three embedded SCSI controllers. Two of these SCSI buses were used to store video data, and the third to store audio. The hard drives were thus connected to the Flyer directly and used a proprietary filesystem layout, rather than being connected to the Amiga's buses and were available as regular devices using the included DOS driver. The Flyer used a proprietary Wavelet compression algorithm known as VTASC, which was well regarded at the time for offering better visual quality than comparable Motion JPEG based non-linear editing systems.

Until 1993, the Avid Media Composer could only be used for editing commercials or other small content projects, because the Apple Macintosh computers could access only 50 gigabytes of storage at one time. In 1992, this limitation was overcome by a group of industry experts lead by a Digital Video R&D team at the Disney Channel. By February 1993, this team had integrated a long form system which gave the Avid Media Composer Apple Macintosh access to over 7 terabytes of digital video data. With instant access to the shot footage of an entire movie, long form non-linear editing (Motion Picture Editing) was now possible. The system made its debut at the NAB conference in 1993, in the booths of the three primary sub-system manufacturers, Avid, SGI and Sony. Within a year, thousands of these

systems replaced a century of 35mm film editing equipment in major motion picture studios and TV stations world wide, making Avid the undisputed leader in non-linear editing systems for over a decade.

Although M-JPEG became the standard codec for NLE during the early 1990s, it had drawbacks. Its high computational requirements ruled out software implementations, leading to the extra cost and complexity of hardware compression/playback cards. More importantly, the traditional tape workflow had involved editing from tape, often in a rented facility. When the editor left the edit suite he could take his confidential video tapes with him. But the M-JPEG data rate was too high for systems like Avid on the Mac and Lightworks on PC to store the video on removable storage, so these used fixed hard disks instead. The tape paradigm of keeping your (confidential) content with you was not possible with these fixed disks. Editing machines were often rented from facilities houses on a per-hour basis, and some productions chose to delete their material after each edit session, and then recapture it the next day, in order to guarantee the security of their content. In addition, each NLE system had storage limited by its hard disk capacity.

These issues were addressed by a small UK company, Eidos plc (which later became famous for its *Tomb Raider* video game series). Eidos chose the new ARM-based computers from the UK and implemented an editing system, launched in Europe in 1990 at the International Broadcasting Convention. Because it implemented its own compression software designed specifically for non-linear editing, the Eidos system had no requirement for JPEG hardware and was cheap to produce. The software could decode multiple video and audio streams at once for real-time effects at no extra cost. But most significantly, for the first time, it allowed effectively unlimited quantities of cheap removable storage. The Eidos Edit 1, Edit 2, and later Optima systems allowed the editor to use *any* Eidos system, rather than being tied down to a particular one, and still keep his data secure. The Optima software editing system was closely tied to Acorn hardware, so when Acorn stopped manufacturing the Risc PC in the late 1990s, Eidos stopped selling the Optima system; by this time Eidos had become predominantly a games company.

In the early 1990s a small American company called Data Translation took what it knew about coding and decoding pictures for the US military and large corporate clients and threw $12m into developing a desktop editor which would use its proprietary compression algorithms and off-the-shelf parts. Their aim was to 'democratize' the desktop — and take some of Avid's market. In August 1993 Media 100 entered the market and thousands of would-be editors had a low-cost, high-quality platform to use.

Inspired by the success of Media 100, members of the Premiere development team left Adobe to start a project called "Keygrip" for Macromedia. Difficulty raising support and money for development lead the team to take their non-linear editor to NAB. After various companies made offers, Keygrip was purchased by Apple as Steve Jobs wanted a product to compete with Adobe Premiere in the desktop video market. At around the same time, Avid — now with Windows versions of its editing software — was considering abandoning the Macintosh platform. Apple released Final Cut Pro in 1999, and despite not being taken seriously at first by professionals, it has evolved into a serious competitor to Avid.

Another leap came in the late 1990s with the launch of DV-based video formats for consumer and professional use. With DV came IEEE 1394 (FireWire/iLink), a simple and inexpensive way of getting video into and out of computers. The video no longer had to be converted from an analog signal to digital data — it was recorded as digital to start with — and FireWire offered a straightforward way of transferring that data without the need for additional hardware or compression. With this innovation, editing become a more realistic proposition for standard computers with software-only packages. It

enabled real desktop editing producing high-quality results at a fraction of the cost of other systems.

More recently the introduction of highly compressed HD formats such as HDV has continued this trend, making it possible to edit HD material on a standard computer running a software-only editing application.

Avid is still considered the industry standard, with the majority of major feature films, television programs, and commercials created with its NLE systems. Avid products were used in the creation of every film nominated in the Best Picture, Directing, Film Editing, Sound Editing, Sound Mixing, Visual Effects, and Animated Feature categories of the 2005 Academy Awards. Avid systems were also the overwhelming NLE choice of the 2004-2005 Primetime Emmy Award nominees, being used on more than 50 shows in eleven major categories. Final Cut Pro continues to develop a strong following, and the software received an Technology & Engineering Emmy Award in 2002.[1] (http://www.apple.com/hotnews/articles/2002/08/emmy/)

Avid has held on to its market-leading position, but faces growing competition from other, cheaper software packages, notably Adobe Premiere in 1992, and later Final Cut Pro in 1999. These three competing products by Avid, Adobe, and Apple are the foremost NLEs, often referred to as the A-Team [2] (http://www.sonybiz.net/b2b/sony-business-fr/32735-sony-biz-france-sony-works-with-a-team-adobe-apple-avid-medical-actualites.html).

Quality

One of the primary concerns with non-linear editing has always been picture and sound quality. The need to compress and decompress video leads to some loss in quality. While improvements in compression techniques and disc storage capacity have reduced these concerns, they still exist. Most professional NLEs are able to edit uncompressed video with the appropriate hardware.

With the more recent adoption of DV formats, quality has become an issue again: DV's compression means that manipulation of the image can introduce significant degradation. However this can be partially avoided by rendering DV footage to a non-compressed intermediary format, thereby avoiding quality loss through recompression of the modified video images. Ultimately it depends on what changes are made to the image, simple edits should show no degradation, however effects that alter the colour, size or position of parts of the image will have a more negative effect.

The range of user-friendly editing tools has given inexperienced people access to editing at high quality for the first time.

See also

- Hard disk recorder
- Linear video editing
- List of video topics
- Film editing
- List of video editing software
- Comparison of video editing software
- Video editing software
- HDV

- EditDroid

External links

- A page about the CMX 600, the very first non-linear video editor (http://www.sssm.com/editing/museum/offline/cmx600.html)
- Linear vs. Non-linear editing (http://www.cybercollege.com/tvp056.htm)
- A link to a downloadable episode of the TV show "The Computer Chronicles" from 1990, which includes a feature on the first Avid Media Composer (http://www.archive.org/details/desktopvideo)
- Article which shows some recent NLE software and a dedicated NLE system (http://www.cybercollege.com/tvp056.htm)
- An article on the history of video editing, with mentions of the first NLE systems (http://www.tvtechnology.com/features/Focus-on-editing/a_Editing_tracks_in.shtml)

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Video processing expansion card

From Wikipedia, the free encyclopedia
(Redirected from Video capture card)

A **Video processing expansion card** is a computer expansion card that allows a computer to receive television signals, record video, and/or playback video content. [1]

Contents

Video capture

Video capture cards are a class of video capture devices designed to plug directly into expansion slots in personal computers and servers. Models from many manufacturers are available; all comply with one of the popular host bus standards including PCI, newer PCI-Express (PCIe) or AGP bus interfaces. High Definition cards are exclusive to PCIe whereas Standard Definition can be found in all three formats.

These cards typically include one or more software drivers to expose the cards' features, via various operating systems, to software applications that further process the video for specific purposes. As a class, the cards are used to capture baseband analog composite video, S-Video, and, in models equipped with tuners, RF modulated video. Some specialized cards support digital video via digital video delivery standards including Serial Digital Interface (SDI) and, more recently, the emerging HDMI standard. These digital models often support both Standard definition and High Definition variants.

While most PCI and PCI-Express capture devices are dedicated to that purpose, AGP capture devices are usually included with the graphics adapted on the board as an all-in-one package. Unlike video editing cards, these cards tend to not have dedicated hardware for processing video beyond the analog-to-digital conversion. Most, but not all, video capture cards also support one or more channels of audio.

There are many applications for video capture cards including converting a live analog source into some type of analog or digital media, (such as a VHS tape to a DVD), archiving, video editing, scheduled recording (such as a PVR), television tuning, or video surveillance. The cards may have significantly different designs to optimally support each of these functions.

One of the most popular applications for Video Capture cards is to capture video and audio for live Internet video streaming. The live stream can also be simultaneously archived and formatted for playable-on-demand video (VOD). The capture cards used for this purpose are typically purchased, installed, and configured in host PC systems by hobbyists or systems integrators. Some care is required to select suitable host systems for video encoding, particularly HD applications which are more affected

by CPU performance, number of CPU cores, and certain motherboard characteristics that heavily influence capture performance.

System-level products are also available preconfigured for these applications; these are typically called Video Encoders or Media Encoders and include a complement of relevant application software.

Video editing

Once a video source is digitally encoded in the computer, it can be edited with a variety of software tools available for the given computer platform. However, some capture cards are designed with this specifically in mind. These cards often have dedicated hardware for the express purpose of handling the rendering of video streams (instead of the CPU). Some of these cards even offer real-time video editing, or a specialized monitor connection which only displays the output of a video being edited as it would appear on a TV (sometimes an actual TV is used).

Editing cards also assist in the dubbing of sound on video clips, adding new sounds, synchronization of sound with video clip (e.g. lip movements are perfectly matched with dialogues), and other common post-production tasks like title generation.

External Capture Device

While external devices operate outside the PC chassis in most cases, their functionality is largely the same, in some cases identical silicon. Instead of using a PCI or AGP interface, an external device would use USB, Firewire, or a PC card to interface with the computer. These devices are more commonly associated with mobile or laptop computing because of their small sizes or portability.

Some (primarily Sony) MiniDV and Digital8 camcorders have analog inputs that can transcode to DV digital video and simultaneously output same via FireWire to a computer - these could also be recognized as video capture devices.

Manufacturers

- Matrox
- Pinnacle Systems
- Canopus
- ATI
- Turtle Beach
- Hauppauge
- Plextor
- Compro Technology
- Darim Vision
- Ituner
- ViewCast

See also

- Expansion card

- Video

References

1. ^ White Paper. Video 101 (http://www.ati.com/products/catalyst/video_WhitePaper.pdf). ATI TECHNOLOGIES INC.. Retrieved on 2006-07-18.

External links

- Index of video capture hardware, from Video4Linux Wiki (http://linuxtv.org/v4lwiki/index.php/Main_Page)
- List of video capture cards (http://linuxtv.org/v4lwiki/index.php/List_survey_of_cards_in_use_now)

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Categories: Articles that may contain original research since September 2007 | Graphics hardware

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VIDEO 101:

INTRODUCTION:

Understanding how the PC can be used to receive TV signals, record video and playback video content is a complicated process, and unfortunately most documentation available on the subject tends to focus on the unnecessary technical and mathematical details. This document takes a different approach by explaining the mechanics, as well as a lot of background information that is usually left out of most explanations on how video and the PC work together.

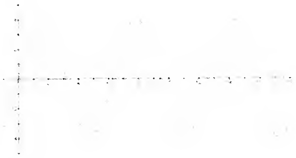
From a high level, the PC can be used to accomplish two tasks involving video:

1. Capturing video (recording a TV station or other video source such as a camcorder)
2. Displaying video (displaying a TV signal, recorded video content, DVD, or streaming video from the web) on a display (such as a PC monitor, HDTV, etc.)

Both of these tasks are actually more complicated than they sound and require dedicated hardware and software to accomplish both. The first half of the article describes how video is captured, and the second half covers how video is displayed.

Because the terms "analog" and "digital" are so important to understanding video it would be helpful to the give a short explanation of what both of these terms mean:

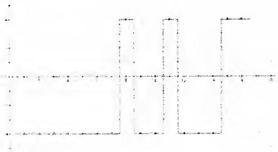
Analog: An analog signal can be thought of as a way of describing a process or event with an infinite level of detail. The signal below is an example of an analog signal; it is continuous, described with an infinite number of points and changes continuously with respect to time.



Analog signals are relatively easy to create, but unfortunately they are very prone to distortion. Transmitting signals always introduces distortion (also known as noise), and as analog signals are infinitely precise, introducing distortion can very easily destroy the quality of the signal – to the point where it is completely lost as seen in the figure below.

Hence the need for digital signals...

Digital: A digital signal offers a way of describing a process (an audio or visual signal for example) with a pre-defined amount of information. The digital signal example seen below can only be set to two values (either +4 or -4) with respect to time.



When an analog signal is digitized, it is described with a finite number of values (whereas before as an analog signal it was described with an infinite number of values). The greater the number of values used the more accurate the representation of original analog signal. An integral portion of many technologies involves deriving a digital signal from an analog source. Digital signals are much easier to work with and much easier to transmit than analog signals.

The creation of a music CD is a great example of converting an analog source into a digital one. The original analog music is sampled (about 44000 times a second) to create a digital representation of the original signal. Because the music on the CD is now in a digital format it is now much more difficult to distort the signal, as compared to most tapes or records which usually contain varying degrees of distortion.

PART 1 - CAPTURING VIDEO

Capturing Video can actually be broken down further into the following sub steps:

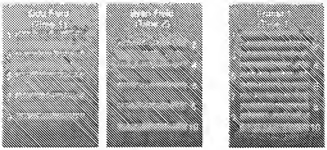
1. Receiving and demodulating TV signals
2. Video Decoding
3. Video Pre-processing
4. Video Compression

1. Receiving and demodulating the TV Signal.

The TV signal receiver (tuner) found on every ATI All-In-Wonder RADEON graphics card or ATI TV Wonder card is the first requirement for capturing a TV signal. The TV tuner operates by allowing the user to select different TV channel frequencies. To understand the whole process of receiving a TV signal it would be helpful to discuss some basics of Television operation and what a TV signal really is.

First, let's very quickly review how TVs actually draw an image on screen. TVs create images by drawing (scanning) lines of light on the face of the screen, left to right, top to bottom to produce the picture over the entire screen. There are two different ways of drawing these lines; interlaced, and progressive. The interlaced method works by drawing alternating fields of even and odd lines (i.e. the first field draws the 1,3,5,... lines, the second field draws the 2,4,6,... lines). The result is that only half of an actual frame is drawn at a time – if displayed quickly enough (60 times a second for example on TVs in North America) the video appears fluid. Unfortunately due to the nature of drawing consecutive odd and even fields, flickering and other mild visual imperfections can occur. Progressive on the other hand draws the entire frame (both even and odd fields) at the same time (usually at a rate of 30 times a second). Progressive signals provide higher quality video as the flicker and visual artifacts associated with interlaced displays are no longer present. The figure below demonstrates the difference between interlacing and progressive scanning.

Interlaced format ***Progressive format***



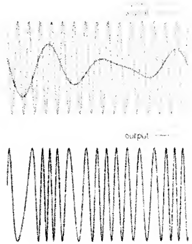
It is also important that we have an understanding of the two types of TV signals that are broadcast: analog and digital. An Analog TV signal refers to the following formats for broadcasting Analog TV content: NTSC – for North America and Japan, PAL for the rest of the world, and SECAM for Europe (primarily France). NTSC signals include 520 scan lines, which are interlaced (approximately 480 are shown, the rest of the lines include synchronization information, closed captioning text, and other information so that your TV can display the rest of the 480 lines) and are shown at a rate of 60 times a second. PAL and SECAM draw 625 scan lines (also interlaced) at a rate of 50 times a second. Higher quality analog TVs are capable of showing all 480 scan lines (TVs that are capable of showing 480 scan lines – both interlaced and progressive are referred to as SDTVs or standard definition TVs) cheaper TVs show fewer scan lines, in the 200 – 300 range.

Digital television signals are still hard to come by, but this is changing quickly, and it is expected that within the next few years many TV stations will switch over to Digital signals exclusively. To be classified as a digital television signal, the signal must fall into one of the following categories: 1080i, 720p, 480i, 480p. The meaning behind these numbers is easily explained; the number indicates the number of scan lines (scan lines just refer to the horizontal lines drawn on the TV that make up the image) actually drawn on the digital TV, the ***i*** indicates that the television signal is interlaced, and the ***p*** indicates that the signal is progressive. Any of the above digital TV signal formats can be shown at 60, 30 or 24 frames/fields (frames for progressive signals, or fields for interlaced signals) per second.

The most popular kind of television for showing digital content is the HDTV (high definition television). The HDTV classification indicates that the TV must support

a certain sub-set of digital signals; 720p, 1080i, which means that the signal must be drawn with 720 progressive scan lines with 1280 pixels (a pixel is a small dot on the TV screen that contains color information) per line, or 1080 interlaced scan lines with 1920 pixels per line. All HDTV signals must have an aspect ratio of 16:9 – also known as wide-screen format. This ratio simply refers to the ratio between the number of pixels shown in the vertical and horizontal direction. Standard definition TV signals will display 480 interlaced scan lines with 704 or 720 pixels per line, which gives an aspect ratio of 4:3. Enhanced definition TVs use identical modes as Standard definition TVs except the 480 scan lines are progressive instead of interlaced.

Once the TV signal has been received by the TV tuner, the signal must then be demodulated. To understand the concept of demodulation it would be useful to give a bit of background on how signals (TV, radio, etc.) are transmitted and broadcast. Most signals (such as TV, radio, cell phone, etc.) are not broadcast from communication towers as is, they are piggy-backed onto specific high frequency signals called carrier signals – this process is called modulation (there are a number of different ways a signal and the carrier wave can be modulated; Amplitude Modulation (AM), Frequency Modulation (FM), Pulse Modulation (PM), etc. The modulation example we'll quickly discuss is frequency modulation, which is used for all FM radio signals. For any radio station the number before the FM, say "92 FM" specifies the frequency (in this case 92 MHz) of the carrier signal for that radio station. An example of frequency modulation is shown below:



There are a couple reasons why signals are modulated. One reason is that it makes transmitting and receiving signals much simpler (this has to do with wavelength size of the signal – the lower the frequency the bigger the wavelength, which makes it harder to transmit and receive signals). Second, if signals were not modulated with unique carrier signals, all signals would interfere with one another, destroying the content of the signals with the same frequency. Once the signal has been received – the real signal and the carrier signal need to be separated from one another. The process of separating the two signals is called demodulation.

For TV signals the demodulator must demodulate both the Video and Audio signals from the carrier signal. ATI's new Theater 550 PRO demodulator is able to separate the audio and visual components of the signal flawlessly.

2. Video Decoding:

Once the TV (both audio and visual components) signal has been separated (demodulated) from the broadcast frequency the signal must be decoded.

To really understand what that means it is necessary to review the components of a TV video signal.

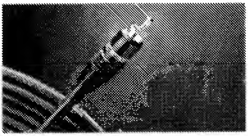
There are two main components of a TV video signal, Luminance(Y) and Chrominance (C). The Luminance (Y) component describes the black and white portion of the video signal (the luminance portion of the signal is used for black and white TVs) and the Chrominance (C) describes the color portion of the TV signal. The Chrominance portion of the TV signal can actually be broken down further into two sub components (blue and red), CbCr for digital signals and PbPr for analog signals. The reason why TV signals are described in terms of Luminance and Chrominance is to save bandwidth (the more bandwidth required the more money it costs to transmit a signal) when transmitting the signal. The Human eye is actually much more sensitive to the Luminance (the black and white) portion of the signal than the color component, so TV signals actually drop some of the color information to reduce the bandwidth required to transmit the TV signal.

Composite video, S-video and Component video are all terms used to describe the separation (or lack thereof) of the different components of a video signal, and are actually names for the different kinds of video cables that can be hooked to your TV. The visual quality of displaying a video signal as individual components is significantly higher than a video signal with the video components combined.

Composite video: describes a signal where the Luminance (Y) and Chrominance (C) components are combined into one signal. This is the lowest quality of signal. Analog TV signals are broadcast in this format.

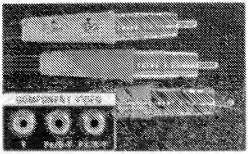
S-Video: describes a signal as two separated components, Luminance(Y) and Chrominance (C). This is an improvement over composite video.

Component video: describes a signal as three separated components, Luminance (Y), and two Chrominance components (CbCr –for digital signals, or PbPr – for analog signals). Component video is the highest level of video quality.



Composite Video

S-Video



Component Video

Do not be confused by the many different ways of describing the format of a video signal. Signal descriptions such as YPbPr, YCbCr, and YUV are all just slightly different ways of describing the Luminance and Chrominance components of a video signal.

When describing a component video signal it is also common to include information on the number of bits being used to describe each of the components. The video signal on all DVDs is stored in digital component form (YCbCr) and is stored in 4:2:0 format. This indicates that the Luminance component of the signal is sampled at a rate of 8-bits per pixel, and the 2 Chrominance components Cb and Cr are sampled at a rate of 2-bits per pixel each. So the total signal would be described as a 12-bit signal. The highest quality video signal possible is 4:4:4, which means each component is sampled at a rate of 8-bits per pixel, adding to a full 24 bits per pixel sample rate. The human eye is far less sensitive to the color portion of the video so this compression has virtually no impact of the quality of DVD video.

Another form of describing a video signal is RGB. RGB is a very different way of describing a video signal, instead of separating the signal into Luminance and Chrominance, the signal is described in terms of three different colors – Red, Green, and Blue. All TVs actually convert the Luminance and Chrominance based TV signals into RGB signals before displaying the video signal on the TV screen.

So, the job of the video decoder is to separate the TV signal into its Luminance and Chrominance components. The actual part of the decoder that does this is the "Comb filter". Modern TVs make use of two types of comb filters; 2D and 3D adaptive comb filters. 2D comb filters are used when there is significant motion in the frame. 2D comb filters operate by using multiple (the more the lines used in the filter, the higher quality the separation of Luminance and Chrominance) scan lines as they are drawn on screen to filter out the Luminance and Chrominance components of the video signal. The 3D adaptive comb filter uses scan lines from the current and future frames to separate the Luminance and Chrominance components from frames that are static.

The ATI Theater 550 Pro uses a per-pixel algorithm to determine which kind of comb filter should be used on a per pixel basis. The per-pixel algorithm ensures that every single pixel receives the right kind of filtering, resulting in highest possible quality video. At this point in time the video signal is now in a digital format.

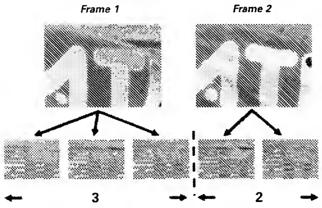
3. Video Pre-processing:

The next stage in the process is video pre-processing. Once a signal has been converted to a digital signal there is still a lot of noise (Any digital signal that was originally derived from an analog signal will have a certain amount of noise), which needs to be removed before compressing the video. Noise, generally refers to white noise and other visual imperfections.

A good de-noise algorithm not only provides better video quality but also improves video encoder compression efficiency to generate higher compressed video content. The end result is that less bandwidth is needed to transmit the video signal.

3:2 pull-down is also used as a video pre-processing technique for converting video content between interlaced 60 fields-per-second format and progressive 24 frames-per-second film format. 3:2 pull–down converts sets (in repeated patterns of 3 and 2) of fields into individual frames, or by breaking up individual

frames into sets 3 or 2 fields. The figure below shows how 24 progressive frames are converted into 60 fields. In this case pull-down converts every two frames into 5 fields. The first frame is broken into 3 fields (one field of even lines, and one field of odd lines, and a repeat of the even line field). The second frame is broken into 2 fields (one field of even lines, one field of odd lines). This pattern is repeated on each frame so that 24 full frames are converted into 60 fields every second.



4. Video Compression:

The video content is now ready to be compressed (so that it can fit onto different Mediums such as a CD or DVD (without compression a standard movie would require around 30 DVDs) using the MPEG standard. MPEG (Motion picture experts group) just refers to method of compressing raw video format so that it can fit onto different mediums. There are a few different variants of MPEG – MPEG-1, MPEG-2, and MPEG-4. MPEG-1 was initially designed for CD videos, MPEG-2 is the format used on all DVDs. MPEG-4 is a new more efficient compression method designed with interactive content in mind (interactive video applications and multimedia content).

MPEG-2 encoding is very computationally intense and requires many advanced algorithms (which we will not cover) that compresses video content that requires a bandwidth of approximately 160 Megabits (one million bits) per second down to 4-8 Megabits per second, while maintaining the same resolution and introducing only minor artifacts.

Although MPEG-2 encoding may be done 100% in software only, it is a very slow and cumbersome process. It is a necessity to use dedicated hardware of the Theater 550 Pro to achieve fast and efficient encoding.

Once the video has been encoded as MPEG-2 it must be either written to the hard drive, or be streamed to the user (which requires transferring the video to system RAM).

PART 2 – PLAYING VIDEO

Once video content has been compressed into MPEG-2 format, a significant amount of effort must now go into decoding or uncompressing the video so that it may be shown on a user's display. The following steps are required to decode and display the video content:

1. Inverse discrete cosine transform (IDCT)
2. Motion Compensation
3. FULLSTREAM™ – when viewing streaming content
4. De-interlacing
5. Scaling
6. Selecting a device to view video content

1. Inverse discrete cosine transform (IDCT):

During encoding, a mathematical function called a discrete cosine transform (DCT) is applied to all of the video content, which makes it much easier to compress (to be more exact throw out pieces of information that are not important to the visual quality of the video). The DCT transforms are actually done on blocks of pixels 8x8 in size. Once the video data has been transformed a further level of encoding called run-level encoding is performed, which removes redundant information from the video data.

The Inverse discrete cosine transform (IDCT) engine found in all RADEON graphics cards reverses this entire process during MPEG-2 decoding, decompressing the image on a block-by-block basis.

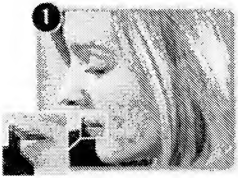
2. Motion Compensation:

Once IDCT completes the decompression of the raw video data, motion compensation is then performed to generate the final fully decoded video images. Motion compensation uses a concept known as predictive coding, which is widely used in video compression. Typically, only a fraction of an image changes from frame-to-frame, which makes it quite easy to predict future frames from previous frames. Motion compensation is used as part of this predictive process. If an image sequence includes moving objects, then their motion within the scene can be measured, and this information may be used to predict the content of frames in the sequence. Without proper motion compensation hardware support, you are likely to see video artifacts, or banding in areas of gradually changing color.

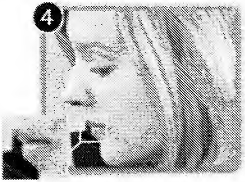
All RADEON hardware provides full support for hardware motion compensation.

3. FULLSTREAM™ support for streaming video content:

Unfortunately when streaming video content (from sources such as the internet) there can be issues with maintaining video quality due to limited bandwidth, resulting in poor visual quality. FULLSTREAM™ a technology developed by ATI significantly improves visual quality for cases when bandwidth is limited. Without sufficient bandwidth pixilation and large blocky artifacts can be seen during video playback as a result of the reduction in video data being streamed. FULLSTREAM™ works by intelligently detecting the edges of these visible artifact blocks and smoothes them over using an advanced filtering technique using the hardware available on RADEON DirectX 9 parts.



Original video frame with blocky artifacts



Improved video frame from FULLSTREAM™

FULLSTREAM™ operates first by analyzing the frame of the video and determines which blocks of the frame are corrupt. Once such artifacts are detected FULLSTREAM™ examines the corrupted pixels and adjusts their color values accordingly. As a result the FULLSTREAM™ video will be greatly improved.

4. De-interlacing:

As previously mentioned the majority of video source data is recorded and stored in interlaced format. This format is used for historical reasons and was originated to maximize the efficiency of transmitting data. Interlaced content is actually broken down into fields (even and odd fields, when combined give one frame).

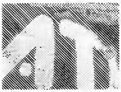
Most PC monitors use progressive scanning, which as previously mentioned means that they render all lines in a single top-to-bottom pass and require twice as much detail as interlaced scanning. The end result is that video data must be converted from interlaced fields to progressive frames to be rendered on a PC. This process is called de-interlacing.

Two simple kinds of de-interlacing methods exist – bob and weave. Weave de-interlacing uses lines from the previous or next field to fill in the missing lines. This works well if there is no motion between the two fields that are woven together. If there are large changes between one field and the next then an artifact known as feathering can occur. Fast scrolling text will look the worst when using weave.

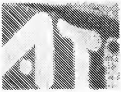
Bob de-interlacing works by only displaying the current field and interpolating between the lines to try and come up with a proper frame. This works well when there is a lot of motion if the picture but can result in fuzziness.

ATI hardware uses adaptive de-interlacing, which actually looks at each pixel and decides whether it should use weave or bob de-interlacing (by detecting whether there is motion; the hardware checks for feathering to determine if there is motion). Adaptive de-interlacing provides the highest level of visual quality.

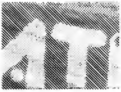
DE-INTERLACING TECHNIQUES



Weave de-interlacing



Bob de-interlacing

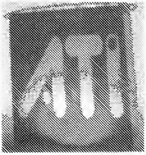


ATI's adaptive de-interlacing technique

5. Scaling:

When watching video content users often want to change the size of their video display window. Changing the size of the video display window using hardware acceleration is known as scaling.

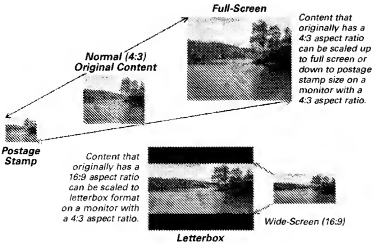
Scaling an image to an arbitrary size requires a high-quality scaling engine to prevent aliasing (seeing jagged lines on the edges within the scene) when downscaling and to retain sharpness when up-scaling.



Jagged lines are a result of aliasing

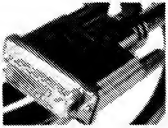
RADEON hardware supports scaling in hardware by using 4x4 pixel sample blocks to create scaled video content. Using hardware accelerated scaling users can upscale or downscale by a ratio of 64:1. Scaling can also be used to change video content from 4:3 aspect ratio to a 16:9 aspect ratio, and vice versa.

EXAMPLES OF VIDEO SCALING



6. Display devices available:

There are number of different displays available – LCD, Plasma, CRT, HDTV, and SDTV, all of which can be connected to the PC using different connection types. Below is quick summary of the different kinds of connections found on ATI graphics cards and what they mean.



DVI (digital video interface): Signals that pass through a DVI connection are digital. More expensive LCD and Plasma displays have DVI connectors which will plug into the DVI connector on the PC graphics cards. Some digital TVs (either HDTV or SDTV) will also attach to the PC graphics card using the DVI connection.

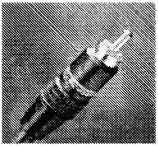
HDMI (high definition multimedia interface): Signals that pass through a HDMI connection are digital. HDMI is also known as the second generation of DVI as HDMI includes the digital audio signal as well as the digital video signal. The HDMI connector is also smaller than the DVI connector. This is a new technology and most likely will not become popular for another year or so. There are adapters available that allow DVI connectors to attach to HDMI based display devices – but the audio portion of the signal is lost. Separate cables must still be used for the audio.

SCART (Syndicat des Constructeurs d'Appareils Radiorécepteurs et Téléviseurs): Signals that pass through a SCART connection are analog. SCART combines audio and video signals and is primarily only used in Europe (particularly France).

VGA (video graphics adapter): Signals that pass though a VGA connector are analog. Most CRTs (cathode ray tube) displays have this kind of connector. Cheaper LCD and plasma displays use a VGA connector to attach to the graphics card.

ATI CATALYST

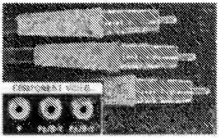
Composite: Signals that pass through a composite connection are analog. As mentioned earlier a composite connector has Luminance and both Chrominance components combined into one signal, which significantly reduces the quality of the signal.



Any TV will connect to a PC graphics card using a Composite connection. Connecting an analog TV to the PC using a composite connection will allow the user to either capture video from a variety of sources (web-cam, game console, camcorder, or analog TV signals) or use the analog TV as a display device for their PC.

S-video: Signals that pass through an S-Video connection are analog. As mentioned earlier S-Video connections have the Luminance and Chrominance signals separated into two components, which offers improved quality over composite quality signals. Most analog TVs will connect to a PC graphics card using an S-Video connection. Using an S-video connection, users can either capture video or use their analog TV as a display device for their PC.

Component: Signals that pass through a component connection are analog. Component connectors have the Luminance and Chrominance (broken into two sub-components) broken into three separate signals, offering a very high quality video connection. Many HDTVs and SDTVs will attach to a PC graphics card using component video connectors.



SUMMARY:

As you can see the process of capturing and showing video is quite a complicated process, and requires dedicated hardware and software support to make it all happen. Luckily for end-users, ATI's graphics solutions take care of all these complicated details, making the process of setting up and viewing TV or other video content on the PC a very simple process.

ATI TECHNOLOGIES INC.
1 Commerce Valley Drive East
Markham, Ontario, Canada L3T 7X6
Telephone: (905) 882-2600
Facsimile: (905) 882-2620
www.ati.com

ATI TECHNOLOGIES SYSTEMS CORP.
4555 Great America Parkway,
Suite 501Santa Clara, CA 95054
Telephone: (408) 572-6500
Facsimile: (408) 572-6305

ATI TECHNOLOGIES (EUROPE) GMBH
Keltenring 13
D-82041 Oberhaching, Germany
Telephone: +49 89 665 15-0
Facsimile: +49 89 665 15-300

ATI TECHNOLOGIES (JAPAN) INC.
Kojimachi Nakata Bldg 4F
5-3 Kojimachi, Chiyoda-Ku
Tokyo 102-0083, Japan
Telephone: +81 35275-2241
Facsimile: +81 35275-2242

ATI TECHNOLOGIES LTD.
9F, No. 2, Sec. 3, Min-Chuan E. Road,
Taipei 104, Taiwan, R.O.C.
Telephone: +886-2-2516-8333
Facsimile: +886 2 2518 8799

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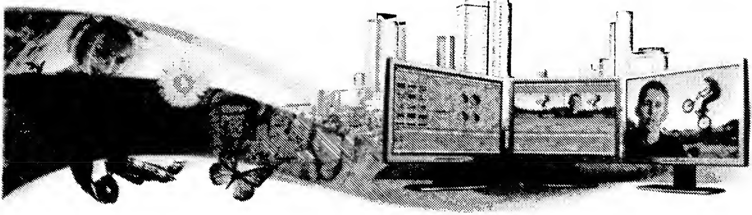
Release 3.1

matrox RT.X2



Professional realtime HD and SD editing platforms
for Adobe CS3 Production Premium

If you're a professional video editor concerned about getting maximum productivity from Adobe Premiere Pro CS3 and Adobe CS3 Production Premium, have a look at the Matrox RT.X2 product line – the ideal solutions for corporate communicators, event videographers, project studios, educational facilities and digital filmmakers. If you're delivering your work in SD, Matrox RT.X2 SD is right for you. If you need the flexibility to edit and view HDV or P2 MXF 720p and output HD, choose Matrox RT.X2.

Both Matrox RT.X2 SD and Matrox RT.X2 go far beyond the capabilities of software-only editing and systems that combine Adobe Premiere Pro CS3 and a simple I/O card. The additional benefits you get include:

- Many more realtime layers of video and graphics
- More effects in real time including color correction, chroma/luma keying, speed changes, blur/glow/soft focus, 3D DVE and much more
- Extensive camera support with Matrox RT.X2 including many new models from Canon, JVC, Panasonic, and Sony
- Native editing of Panasonic P2 MXF 720p and SD files with Matrox RT.X2
- Capture from analog sources to compressed MPEG-2 4:2:2 I-frame
- Realtime playback of 32-bit MPEG-2 I-frame AVI files with alpha
- Realtime mixed format multi-cam
- Accelerated export to DVD and all multimedia formats
- Composite, Y/C, and analog component input and output
- WYSIWYG video output for motion graphics, animation, and compositing applications
- Audio VU meters on capture
- Full-resolution HD monitoring on an inexpensive flat panel display via independent DVI output with Matrox RT.X2

With the Matrox RT.X2 platforms, you'll save time on every project so you can concentrate on creating your best work and building your business. There are three products to choose from. Matrox RT.X2 is available as a value-priced bundle with Adobe Premiere Pro CS3 or as hardware-only for use with your copy of the Adobe software. Matrox RT.X2 SD is available as hardware-only.

Matrox RT.X2 and Adobe Premiere Pro CS3 bundle

Matrox RT.X2 hardware-only

Matrox RT.X2 SD hardware-only

Key features of Matrox RT.X2

Professional realtime HD and SD editing

- Realtime, mixed-format, multi-layer workflows that combine HD and SD material from analog and digital sources
- Realtime Matrox Flex CPU and Flex GPU effects
- Extensive camera support
- Native HDV 1080i, HDV 1080p, HDV 720p (JVC ProHD), Panasonic P2 MXF 720p, and MPEG-2 4:2:2 I-frame HD editing
- Native DV, DVCAM, DVCPRO, Panasonic P2 MXF SD, and MPEG-2 4:2:2 I-frame SD editing
- Realtime mixed-format multi-cam
- Realtime high-quality hardware downscaling for SD output from an HD timeline
- Accelerated export to DVD and all multimedia formats
- WYSIWYG for Adobe After Effects, Photoshop and Bridge, Autodesk Combustion and 3ds Max, eyeon Fusion, NewTek LightWave 3D, and Windows Media Player with dynamic Alt+Tab switching
- Composite, Y/C, HD/SD analog component input and output
- Full-resolution HD monitoring on an inexpensive flat panel display via independent DVI output
- Available as a bundle with Adobe Premiere Pro CS3 or as hardware-only

Key features of Matrox RT.X2 SD

Professional realtime SD editing

- Realtime multi-layer editing of video, graphics, and effects
- Realtime Matrox Flex CPU and Flex GPU effects
- Native DV, DVCAM, DVCPRO, and MPEG-2 4:2:2 I-frame SD editing
- Realtime HDV clip downscaling in an SD timeline
- Realtime mixed-format multi-cam in an SD timeline
- Accelerated export to DVD and all multimedia formats
- WYSIWYG for Adobe After Effects, Photoshop and Bridge, Autodesk Combustion and 3ds Max, eyeon Fusion, NewTek LightWave 3D, and Windows Media Player with dynamic Alt+Tab switching
- Composite, Y/C, and analog component SD input and output

Capture/editing formats	RT.X2	RT.X2 SD
HDV 1080i	X	capture only
HDV 1080p	X	capture only
HDV 720p	X	—
P2 MXF 720p and SD	X	—
DV, DVCPRO, DVCAM	X	X
MPEG-2 4:2:2 I-frame SD*	10-25 mbps	10-25 mbps
MPEG-2 4:2:2 I-frame HD at 1440 horizontal resolution*	50-100 mbps	
Compressed HD for offline	editing only	
Playback of legacy RT series AVI files	X	X

* Also available as 32 bit AVI with alpha

Realtime video effects**	RT.X2	RT.X2 SD
Three-way primary and secondary color correction	X	X
Super smooth field- or frame-blended slow motion	X	X
Advanced 3D DVE	X	X
Chroma/luma keying	X	X
Dissolve, wipes	X	X
Surface finish	X	X
Blur/glow/soft focus	X	X
Shadow	X	X
Transitions	X	X
Page curls	X	X
Mask, mask mosaic, mask blur	X	X
Pan & Scan	X	X
Four corner pin	X	X
Track matte	X	X
Native Adobe transitions and effects	X	X
Accelerated shine	X	X
Crystallize	X	X
Old movie	X	X
Lens flare	X	X
Move & scale	X	X
Accelerated cube***	X	X
Ripple	X	X
Twirl	X	X
Impressionist	X	X
Adobe garbage mask	X	X
Sphere	X	X
Timecode	X	X

** Certain complex effects at certain resolutions using certain codecs may not playback in real time, but they still benefit from hardware acceleration. The Matrox RT.X2 platforms rely on the power of your system CPU and GPU to process realtime Matrox Flex effects. Please visit our website for system configuration guidelines.

*** Requires CPU with 512 MB

Audio	RT.X2	RT.X2 SD
RCA audio	2-in/2-out†	2-in/2-out†
16 bit, 48 kHz	X	X

† The RT.X2 cards rely on your system sound card to capture and output audio

Video editing	RT.X2	RT.X2 SD
Ultra high performance editing with Adobe Premiere Pro CS3	X	X
Realtime mixed-format timelines	X	SD timelines only
EDL import and export	X	X
AAF export for interoperability with other systems	X	X
Waveform and vectorscope monitors	X	X
User customizable keyboard	X	X
Multiple nestable timelines	X	X
Accelerated export to DVD and all multimedia formats	X	X
WYSIWYG for compositing and graphics applications	X	X
Realtime mixed-format multi-cam	X	SD timelines only

Audio editing	RT.X2	RT.X2 SD
Support for multi-channel 5.1 surround sound mixing and monitoring	X	X
Sub-frame audio editing	X	X
Audio sweetening with VST plug-in support	X	X
Voiceover recording in the timeline	X	X
VU meters on capture	X	X

Video inputs and outputs	RT.X2	RT.X2 SD
Realtime high quality downscaling from HD to SD	X	-
DVI-D preview output	X	—
SD		
1394	X	X
Composite	X	X
Y/C	X	X
Analog component	X	X
HD		
1394	X	input only
Analog YPbPr component	X	

Supported editing resolutions	RT.X2	RT.X2 SD
720p @ 23.98, 25, 29.97, 50, 59.94	X	-
HDV 1080i (1440 x 1080) @ 25, 29.97	X	—
HDV 1080p (1440 x 1080) @ 23.98, 25, 29.97	X	—
NTSC	X	X
PAL	X	X
486p @ 23.98, 29.97	X	X
576p @ 25	X	X

General	RT.X2	RT.X2 SD
PCIe 1x card requirements	full length	standard

www.matrox.com/video

Corporate Headquarters — Matrox Video Products Group

Tel: (514) 822-6364 (800) 361-4903 (North America) • Fax: (514) 685-2853 • E-mail: video.info@matrox.com

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Ear Force SPC
Ear Force W3
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Ear Force X1
Ear Force X2
Ear Force X3
Montego DDL
Riviera
Video Advantage USB
Video Advantage PCI
Video Advantage ADX

Software Products

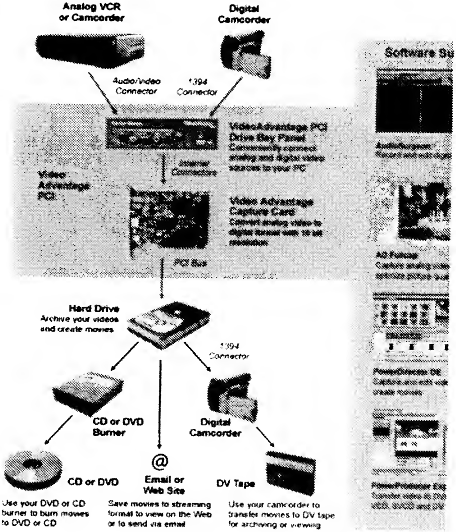
Video Advantage PCI

Price: $149.95

How Does It Work?

Video Advantage PCI is an affordable, full-featured video production syst

for serious amateurs or semi-professionals. It includes everything you need for
videos from digital or analog camcorders and creating movies in a wide variety
including streaming video for the Web, DV tapes, VCDs, SVCDs or DVDs.



AudioSurgeon
MusicWrite Maestro
MusicWrite Songwriter
MusicWrite Starter Kit
Record Producer
Record Producer Deluxe
Record Producer MIDI
Teach Me Guitar
Teach Me Guitar Deluxe
Teach Me Piano
USB Teach Me Piano
USB MIDI Cable
USB Music Studio Kit

Accessories
Cables
Music Reference Guides
Instructional Videos

Quick Help
Support
Knowledge Base
Artwork

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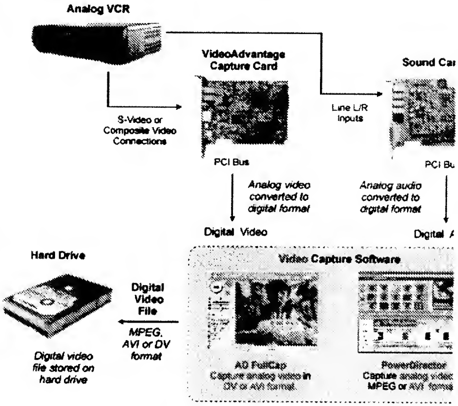
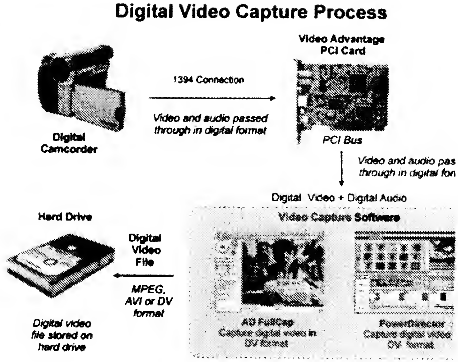
Analog Video Capture Process



In the analog video capture process, the signal from an analog video source is c the analog video and audio connectors on the Video Advantage back panel bracl analog video signal is converted into digital format by the Video Advantage PCI transferred to the hard drive as a digital video file. The analog audio signal is co digital format by the sound card and merged with the digital video signal in the file. This process is controlled by either the AD FullCap or PowerDirector softwar depending on the type of video compression desired.



AD FullCap lets you transfer digital video from your camcorder to the PC hard dr DV compressed or AVI uncompressed formats. PowerDirector lets you transfer d from your camcorder in AVI, MPEG-1 and MPEG-2 formats. If your digital camco OHCI standard, then AD FullCap and PowerDirector can both be used to control from the software's on-screen controls so you can stop, pause, fast-forward, rev record without having to touch the camera controls.

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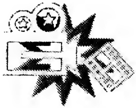


Video Advantage PCI

Price: $149.95

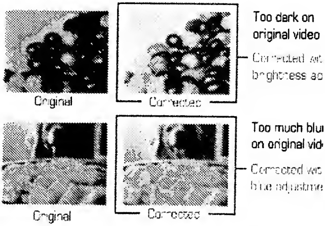
In Detail - Software

Video Advantage PCI includes a full-featured video software suite that l

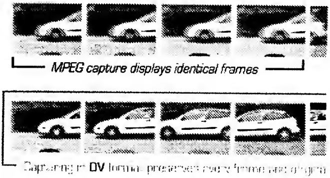
- Capture video from your analog or digital tapes
- Author a movie using the captured video clips
- Create slide shows from your digital photos
- Transfer video to a delivery media such as DVD, SVCD, VCD or streamin(

Feature Highlights Include:

Real-time Color Correction Real-time adjustment of picture quality while you watch.



Analog Video to DV Format Real-time DV encoder converts analog video into high-quality digital format for frame accurate editing.



Time Stretch

Video Advantage USB
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Audio Advantage SRM
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ANR-15
ANR-20
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Ear Force D2
Ear Force HPA2
Ear Force SPC
Ear Force W3
Ear Force X-52
Ear Force XBL
Ear Force X1
Ear Force X2
Ear Force X3
Montego DDL
Riviera
Video Advantage USB
Video Advantage PCI
Video Advantage ADX

Software Products

Adjusts video playback speed without affecting the audio pitch.

Transitions

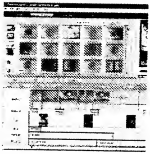
Includes an extensive library of transitions, video effects and titles.

The Complete Video Advantage Software Suite includes:

AD FullCap™ Video Capture Program

- Capture video in AVI or DV type-1 & type-2 formats
- Adjust picture quality of analog videos in real-time
- Capture analog video in DV format for a high-quality digital video file that allows frame-accurate editing
- Create snapshots of your videos while capturing.
- Capture in a wide variety of frame resolutions.
- View video capture statistics while recording.
- Create timed recordings.

PowerDirector™ DE Video Production Program



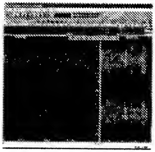
- Capture videos in AVI or MPEG-1, -2 formats.
- Author movies using video clips and digital photos.
- Create slide shows from digital photos.
- Enhance movies and slide shows with transitions, titles, effects, music and sound effects (from the included clip library), or narrations.
- Create a movie file in the proper format for the destination media you choose (e.g.

DVD, SVCD, VCD, etc.)

PowerProducer™ Express CD/DVD Burning Program

- Transfer the movie or slideshow created in PowerDirector to DVD , SVCD, VCS, DV Tape or streaming video for the Web.
- Create a simple DVD from a collection of photos and videos without having to produce a movie.
- Burn video from a camcorder directly to disc.
- Includes utilities for managing DVD content and video files.
- Edit a rewritable disc to add video without having to erase the full disc or burn a new one.
- Erase portions of a rewritable disc to reuse the disc.
- Copy a disc to another disc for others to enjoy, or to make backup copies.
- Copy a project to a disc for archiving or for moving from one PC to another.
- Burn a folder of media files to a disc for backup.

AudioSurgeon™ Audio Editing Program



- Edit digital audio files for use in PowerDirector movies.
- Record your own sounds.
- View sound as a graphical waveform showing every peak and valley.
- Zoom in and change every nuance until it sounds the way you want it, then drop it into your PowerDirector movie.
- Add sound effects.

The Video Advantage Sound Library

- A sound library of music and sound effects for enhancing movies and photo slide shows
- Music files are provided in three different lengths
    - 'Full' is a complete rendition of the song
    - '3 sec' is a three second clip from the song, useful for closing or opening a video clip
    - '30 sec' is a thirty second clip from the song, useful for short clips or to edit into other medleys
- Song clips may be inserted as-is into the audio timeline in your movie or edited with AudioSurgeon to customize the length
- Sound effects are grouped into different style folders describing the category of sounds

AD FullCap	PowerDirector DE	PowerProduc Express

Capture analog video formats	- Analog to AVI - Analog to DV Type-1 - Analog to DV Type-2	- AVI - MPEG-1 - MPEG-2	
Capture digital video formats	- DV to AVI - DV to DV Type-1 - DV to DV Type-2	- DV to MPEG - DV to DV-AVI	
Output video formats		- DV-AVI - MPEG-1 - MPEG-2 - WMV - RealMedia	- DV-AVI - MPEG-1 - MPEG-2 - WMV - RealMedia
Import Audio formats		- WAV - MP3 - WMA	
Export Audio formats			
Edit Audio			
Import Photos		BMP, JPG	BMP, JPG
Author movies		✓	
Create photo slideshows.		✓	✓
Edit Video.		✓	
Burn DVD, SVCD, VCD			✓
Transfer Videos to DV Tape			✓
Create snapshots from video frames	✓	✓	
Adjust video quality in real time	✓	✓	
Timed video recording	✓		
Create video for email and web		✓	

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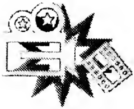
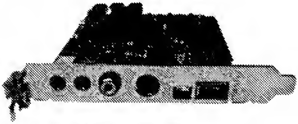


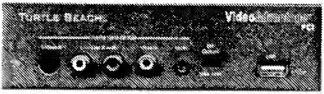
Price: $149.95

What do I get with Video Advantage PCI?

Hardware



Video Advantage Capture Card
A high-speed PCI video capture card with 10-bit video digitizing resolution and a of connectors for capturing analog and digital video.



Video Advantage Drive Bay connector panel
Users who want the ease and convenience of connecting their video sources to t of their PC rather than constantly reaching for the back of their PC can use the i Drive Bay connector panel (not required for use). This panel fits in a standard 5 drive bay right next to your CD or DVD player.

Software

Video Capture

AD FullCap™
Capture analog video in DV format for hig frame-accurate editing compatible with hi video programs

AudioSurgeon ™
MusicWrite Maestro
MusicWrite Songwriter
MusicWrite Starter Kit
Record Producer
Record Producer Deluxe
Record Producer MIDI
Teach Me Guitar
Teach Me Guitar Deluxe
Teach Me Piano
USB Teach Me Piano
USB MIDI Cable
USB Music Studio Kit

Accessories
Cables
Music Reference Guides
Instructional Videos

Quick Help
Support
Knowledge Base
Artwork

Subscribe

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- Bloglines
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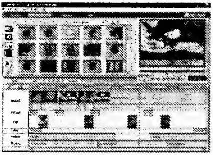
-
- MY YAHOO!
- Newsgator
- Rojo
- Technorati

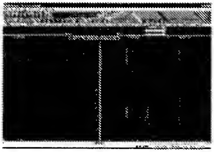


Video Editing

PowerDirector DE™
A complete video capture and production easy to use. Drag video of photos onto a create movies or photo slide shows.

DVD and CD Burning

PowerProducer Express™
Burn a DVD, SVCD or VCD from movies a slide shows created in PowerDirector -- or assemble video clips and photos for viewi complete with menus.



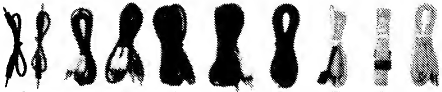
Sound Editing

AudioSurgeon™
Enhance your videos with custom sounds sound library or record your own.

Sound FX and Music Library

A complete sound library with hundreds o and sound effects that can be used to enh movies and slide shows.

Cables



1 2 3 4 5 6 7 8 9

1. Two(2) 1/8" to 1/8" stereo cables For connecting the mic and line jacks c Advantage PCI card to your sound card mic and line inputs.
2. One(1) RCA-to-RCA video cable For connecting analog video sources with video output.
3. One(1) RCA-to-RCA stereo audio cable For connecting the stereo line out analog video source to the Drive Bay audio line inputs.
4. One(1) S-Video Cable

5. One(1) 1/8" to stereo RCA Cable
6. One(1) USB 2.0 type A to B cable For connecting the PC's USB port to th USB connector.
7. One(1) USB 2.0 type A to 4-pin header cable For connecting a USB port motherboard to the drive bay USB connector.
8. One(1) 12-pin ribbon cable For connecting the audio and video signals or Advantage PCI card to the drive bay.
9. One(1) 6-pin 1394 cable For connecting a digital camcorder to the Video PCI card or the drive bay.
10. One(1) 6-pin 1394 cable For connecting the 1394 port on the Video Adva card to the drive bay.

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